BIRLA INSTITUTE OF TECHNOLOGY

BACHELOR IN COMPUTER APPLICATION
CURRICULUM
BASED ON NATIONAL EDUCATION POLICY 2020
(Effective from Academic Session: 2023-24)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

Institute Mission

- To educate students at Under Graduate, Post Graduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

The department strives to be recognized globally for outstanding education and research, leading to excellent professionals and innovators in the field of Computer Science and Engineering, who can positively contribute to the society.

Department Mission

1. To impart quality education and equip the students with strong foundation that could make them capable of handling challenges of the new century.
2. To maintain state of the art research facilities and facilitate interaction with world's leading universities, industries and research organization for constant improvement in the quality of education and research.

Programme Educational Objectives (PEOs)

PEO 1: The program will produce graduates who will be competent professionals in IT industry, academics, government or entrepreneurs.
PEO 2: Graduates will exhibit professional ethics, critical thinking, problem solving and effective communication skills to work collaboratively in a team-based environment.
PEO 3: The graduates will possess leadership qualities and will be capable of attaining higher positions in their professional career.
PEO 4: Graduates will be able to adapt to the fast-changing world of technology and will become effective professionals to address the technical, social and business challenges.
PEO 5: Graduates will recognize the importance of interdisciplinary learning, engage in lifelong learning and professional development.

(A) Programme Outcomes (POs)

Graduates will be able to:

1. **Discipline knowledge:** Demonstrate the comprehensive knowledge of mathematics, computing fundamentals and domain concepts to enhance their professional skills.

2. **Problem analysis:** Apply to identify, formulate and analyze solutions to various computing problems using the fundamental principles of computing.
3. **Design/development of solutions:** Ability to design, develop and implement computer-based solutions to real world problems using appropriate tools and techniques.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modem IT tools including prediction and modeling to challenging problems.
6. **The graduates and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the IT professionals
7. **Environment and sustainability:** Understand the impact of the professional computer-based solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles to maintain the integrity in a working environment in sustainable societal development through objective, unbiased and truthful actions.
9. **Individual and team work:** Ability to work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Express thoughts and ideas effectively in understanding computing activities by writing effective reports, making effective presentations, constructing documentation and presenting complex information in a concise manner.
11. **Project management:** Learn to build a project from pre-implementation to completion within constraints in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) Programme Specific Outcomes (PSOs)

1. The ability to analyze, design, code and test application specific or complex problems in Cryptography and Network Security, Design and Analysis of Algorithm, Computer Networks, Cloud Computing, Mobile Computing, Data Mining and Big Data by applying the knowledge of basic sciences, mathematics and fundamentals.
2. The ability to adapt for rapid changes in tools and technology with an understanding of societal and ecological issues relevant to professional practice through life-long learning.
3. Excellent adaptability to function in multi-disciplinary work environment, good interpersonal skills as a leader in a team in appreciation of professional ethics and societal responsibilities.

PROGRAMME COURSE STRUCTURE

BIRLA INSTUTURE OF TECHNOLOGY-MESRA, RANCHI
COURSE STRUCTURE FOR BACHELOR OF COMPUTER APPLICATION as per NEP-2020
(w.e.f. Academic Session 2023-24)

Semester/ Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical			Total Credits C
					L	T	P	C
		THEORY						
First Monsoon	FIRST	Pre-requisite course *	PR001	Elementary Mathematics	3	0	0	0
		DSC- Elective		DSC- Elective I	3	0	0	3
		DSC-Course	CN105	Basics of Operating Systems	2	0	0	2
		DSC-Course	CN107	Fundamentals of Computer Science	2	0	0	2
		MDC	MN106	Principles of Management	3	0	0	3
		VAC – Elective		VAC Elective I	2	0	0	2
		SEC-SB Elective		SEC-SB Elective I	2	0	2	3
		VAC – Elective		VAC Elective II	1	0	2	2
		LABORATORIES						
		AECC	MT132	Communication Skills-I	0	0	3	1.5
		DSC Lab		DSC Lab – Elective I	0	0	4	2
		TOTAL						20.5

*[will be pass course with no credits]

Semester / Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery & credits L-Lecture; T-Tutorial; P-Practical			Total Credits C
					L (Periods /week)	T (Periods /week)	P (Periods /week)	C
Second Spring	FIRST	**THEORY**						
		DSC-Course	CN121	Introduction to Data Structures	3	1	0	4
		DSC-Course	CN123	Basics of Digital Computer and Logic Design	3	1	0	4
		MDC	CN131	Mathematics for Computing I	3	1	0	4
		VAC – Elective		VAC Elective III	2	0	0	2
		LABORATORIES						
		SEC-SB Elective		SEC-SB Elective II	0	0	4	2
		AECC	MT133	Communication Skills- II	0	0	3	1.5
		DSC Lab	CN122	Data Structure Lab	0	0	4	2
		Internship/ Dissertation	CN130	Internship or work based vocational courses**	0	0	0	4
		Total			**23.5 (Including summer internship)**			

****Vocational course to be offered during Summer term**

EXIT OPTION WITH CERTIFICATION IN COMPUTER APPLICATIONS
Total Credits I Year [DSC Course:19 MDC:6 SEC-SB:6 VAC:6 AECC:3 Internship:4* = 40+4*] =44

Semester/ Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical			Total Credits C
					L (Periods/ week)	T (Periods/ week)	P (Periods /week)	C
Third Monsoon	SECOND	**THEORY**						
		DSC-Course	CN201	Java Programming	3	0	0	3
		DSC-Course	CN203	Database Management System	3	0	0	3
		DSC-Course	CN205	Concept of Programming Languages	2	0	0	2
		MDC	CN207	Mathematics for Computing II	3	0	0	3
		AECC	MN109	Public speaking and creative writing	1	0	2	2
		SEC-SB		SEC-SB Elective III	2	0	2	3
		LABORATORIES						
		DSC Lab	CN202	Java Lab	0	0	4	2
		DSC Lab	CN204	DBMS Lab	0	0	4	2
		TOTAL						**20**

<table>
<tr><th rowspan="2">Semester/ Session of Study (Recommended)</th><th rowspan="2">Course Level</th><th rowspan="2">Category of Course</th><th rowspan="2">Course Code</th><th rowspan="2">Courses</th><th colspan="3">Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical</th><th>Total Credits</th></tr>
<tr><th>L (Periods /week)</th><th>T (Periods /week)</th><th>P (Periods /week)</th><th>C</th></tr>
<tr><td rowspan="11">Fourth Spring</td><td rowspan="11">SECOND</td><td colspan="7">THEORY</td></tr>
<tr><td>DSC-Course</td><td>CN221</td><td>Software Engineering</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>DSC-Course</td><td>CN223</td><td>Python Programming</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>DSC-Course</td><td>CN225</td><td>Computer Networks</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>DSE-Elective</td><td></td><td>DSE Elective I</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>AECC</td><td>MN201</td><td>Personality Development</td><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">LABORATORIES</td></tr>
<tr><td>DSC Lab</td><td>CN222</td><td>Software Engineering Lab</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>DSC Lab</td><td>CN224</td><td>Python Programming Lab</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td colspan="2">Total</td><td colspan="5">20</td></tr>
</table>

EXIT OPTION WITH DIPLOMAIN IN COMPUTER APPLICATIONS

Total Credits after II Year [DSC+DSE :48 MDC :9 SEC-SB :9 VAC : 6 AECC :8Internship :4* = 80+4*] =84

Semester/ Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical			Total Credits
					L (Periods /week)	T (Periods /week)	P (Periods /week)	C
Fifth Monsoon	**THIRD**	**THEORY**						
		DSC-Course	CN301	Fundamentals of Computer Algorithm	3	1	0	4
		DSE-Elective		DSE-Elective II	3	0	0	3
		DSC-Course	CN307	Web Programming	3	0	0	3
		DSC-Course	CN309	Software Testing	3	1	0	4
		LABORATORIES						
		DSE Lab		DSE Lab- Elective II	0	0	4	2
		DSC-Course	CN308	Web Programming Lab	0	0	4	2
		Minor Internship/ Project	CN312	Internship/Project	0	0	0	2
		TOTAL	**20**					

Semester/ Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical			Total Credits
					L (Periods /week)	T (Periods /week)	P (Periods /week)	C
Sixth Spring	THIRD	**THEORY**						
		DSE-Elective		DSE-Elective III	3	1	0	4
		DSC-Course	CN335	Distributed Computing	3	0	0	3
		DSE-Elective		DSE-Elective IV	3	0	0	3
		DSC-Course	CN341	Introduction to Computer Optimization Techniques	3	0	0	3
		LABORATORIES						
		DSE Lab-Elective		DSE Lab-Elective III	0	0	4	2
		DSE Lab-Elective		DSE Lab-Elective IV	0	0	4	2
			CN344	Minor Project	0	0	0	3
			TOTAL					**20**

EXIT OPTION WITH DEGREE (BCA) **Total Credits [I Year + II year +III Year = 44+40 +40= 124]**

SPECIALIZATION –Artificial Intelligence and Machine Learning / Data Science/ High Performance Computing

<table>
<tr><th rowspan="2">Semester/ Session of Study (Recommended)</th><th rowspan="2">Course Level</th><th rowspan="2">Category of Course</th><th rowspan="2">Course Code</th><th rowspan="2">Courses</th><th colspan="3">Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical</th><th>Total Credits</th></tr>
<tr><th>L (Periods /week)</th><th>T (Periods /week)</th><th>P (Periods /week)</th><th>C</th></tr>
<tr><td></td><td></td><td colspan="7">THEORY</td></tr>
<tr><td rowspan="7">Seventh Monsoon</td><td rowspan="7">FOURTH</td><td>DSE-Elective</td><td></td><td>DSE-Elective V Annexure A/Annexure B/ Annexure C</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>DSE-Elective</td><td></td><td>DSE-Elective VI Annexure A/Annexure B/ Annexure C</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>DSE-Course</td><td>CN407</td><td>Research Methodology</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>DSE-Elective</td><td></td><td>DSE-Elective VII Annexure A/Annexure B/ Annexure C</td><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="7">LABORATORIES</td></tr>
<tr><td>DSE Lab-Elective</td><td></td><td>DSE Lab- Elective V Annexure A/Annexure B/ Annexure C</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>DSE Lab-Elective</td><td></td><td>DSE Lab-Elective VI Annexure A/Annexure B/ Annexure C</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td></td><td></td><td colspan="3">TOTAL</td><td></td><td></td><td></td><td>20</td></tr>
</table>

<table>
<tr><th rowspan="2">Semester/ Session of Study (Recommended)</th><th rowspan="2">Course Level</th><th rowspan="2">Category of Course</th><th rowspan="2">Course Code</th><th rowspan="2">Courses</th><th colspan="3">Mode of delivery and credits L-Lecture; T-Tutorial; P-Practical</th><th>Total Credits</th></tr>
<tr><th>L (Periods /week)</th><th>T (Periods /week)</th><th>P (Periods /week)</th><th>C</th></tr>
<tr><td></td><td></td><td colspan="7">THEORY</td></tr>
<tr><td rowspan="5">Eighth Spring</td><td rowspan="5">FOURTH</td><td>DSE-Elective</td><td></td><td>DSE-Elective VIII Annexure A/Annexure B/ Annexure C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>DSE-Elective</td><td></td><td>DSE-Elective IX Annexure A/Annexure B/ Annexure C</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">LABORATORIES</td></tr>
<tr><td>DSE Lab-Elective</td><td></td><td>DSE Lab-Elective VIII Annexure A/Annexure B/ Annexure C</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Research Project/Dissertation</td><td>CN470</td><td>Research project /Internship with Viva-voce and seminar presentation.</td><td>0</td><td>0</td><td>0</td><td>12</td></tr>
<tr><td></td><td colspan="4">TOTAL</td><td></td><td></td><td></td><td>20</td></tr>
</table>

AFTER FOURTH YEAR BACHELOR'S DEGREE: BCA HONOURS

Total Credits 164 for 4 years course

Student will select the specialization in one of the followings:

- **Annexure A - Artificial Intelligence and Machine Learning**
- **Annexure B - Data Science**
- **Annexure C- High Performance Computing**

Acronyms Expanded

- AECC : Ability Enhancement Compulsory Course
- DSC : Discipline Specific Core (Course)
- DSE : Discipline Specific Elective (Course)
- VAC : Value Added Course
- SEC-SB : Skill Enhancement Course-Skill Based
- MDC : Multidisciplinary Course

ELECTIVES

DSC Electives

	Course Code	Course	L	T	P	C
DSC-Elective I	CN101	Programming and Problem-Solving using C	3	0	0	3
	CN103	Programming and Problem-Solving using C++	3	0	0	3
DSC Lab – Elective I	CN102	C Lab	0	0	4	2
	CN104	C++ Lab	0	0	4	2

VAC Electives

	Course Code	Course	L	T	P	C
VAC Elective I	MN102	Human Values and Professional Ethics	2	0	0	2
	CN109	Environmental Science	2	0	0	2
VAC Elective II	MN103	Yoga	1	0	2	2
	MN104	Physical Education	1	0	2	2
VAC Elective III	MN111	Digital Empowerment	2	0	0	2
	MN112	Emotional Intelligence	2	0	0	2

SEC-SB Electives

	Course Code	Course	L	T	P	C
SEC-SB Elective I	CN111	Office Automation Tools	2	0	2	3
	CN113	Linux administration	2	0	2	3
SEC-SB Elective II	CN126	MATLAB Programming Lab	0	0	4	2
	CN128	Latex Lab	0	0	4	2
SEC-SB Elective III	CN209	Statistics with R	2	0	2	3
	MN203	Computerized Accounting	2	0	2	3

DSE Electives

	Course Code	Course	L	T	P	C
DSE-Elective I	CN227	Introduction to Data Science	3	0	0	3
	CN229	Introduction to Artificial Intelligence	3	0	0	3
	CN231	Enterprise Resource Planning	3	0	0	3
DSE-Elective II	CN303	Introduction to Machine Learning	3	0	0	3
	CN305	Computer Graphics	3	0	0	3
DSE Lab- Elective II	CN304	Machine Learning Lab	0	0	4	2
	CN306	Computer Graphics Lab	0	0	4	2
DSE-Elective III	CN331	Advanced Java Programming	3	1	0	4
	CN333	Data Analytics	3	1	0	4
DSE Lab- Elective III	CN332	Advanced Java Programming Lab	0	0	4	2
	CN334	Data Analytics Lab	0	0	4	2
DSE-Elective IV	CN337	Introduction to Data Mining	3	0	0	3
	CN339	Introduction to IOT	3	0	0	3
DSE Lab- Elective IV	CN338	Data Mining Lab	0	0	4	2
	CN340	IOT Lab	0	0	4	2

ANNEXURE A: Artificial Intelligence and Machine Learning

Courses and Labs to be taken from following table in 7th and 8th semester

DSE Electives

	Course Code	Course	L	T	P	C
DSE-Elective V	CN401	Deep Learning	3	1	0	4
	CN411	Data Visualization	3	1	0	4
DSE Lab-Elective V	CN402	Deep Learning Lab	0	0	4	2
	CN412	Data Visualization Lab	0	0	4	2
DSE-Elective VI	CN403	Digital Gaming	3	1	0	4
	CN415	Advanced Python Programming	3	1	0	4
DSE Lab-Elective VI	CN404	Digital Gaming Lab	0	0	4	2
	CN416	Advanced Python Programming Lab	0	0	4	2
DSE-Elective VII	CN405	Soft Computing	3	1	0	4
	CN409	Natural Language Processing	3	1	0	4
DSE-Elective VIII	CN413	Advanced Data Analytics	3	0	0	3
	CN421	Reinforcement Learning	3	0	0	3
	CN423	Feature Engineering	3	0	0	3
DSE Lab-Elective VIII	CN414	Advanced Data Analytics Lab	0	0	4	2
	CN422	Reinforcement Learning Lab	0	0	4	2
	CN424	Feature Engineering Lab	0	0	4	2
DSE-Elective IX	CN417	Computer Vision	3	0	0	3
	CN419	Image Processing	3	0	0	3

ANNEXURE B: Data Science

Courses and Labs to be taken from following table in 7th and 8th semester

DSE Electives

	Course Code	Course	L	T	P	C
DSE-Elective V	CN425	No SQL Data Base	3	1	0	4
	CN431	Cloud Computing	3	1	0	4
DSE Lab-Elective V	CN426	No SQL Lab	0	0	4	2
	CN432	Cloud Computing Lab	0	0	4	2
DSE-Elective VI	CN415	Advanced Python Programming	3	1	0	4
	CN433	Data Preprocessing and Reporting	3	1	0	4
DSE Lab-Elective VI	CN416	Advanced Python Programming Lab	0	0	4	2
	CN434	Data Preprocessing and reporting Lab	0	0	4	2
DSE-Elective VII	CN405	Soft Computing	3	1	0	4
	CN427	Data Ethics and Privacy	3	1	0	4
	CN429	Cryptography & Network Security	3	1	0	4
DSE-Elective VIII	CN413	Advanced Data Analytics	3	0	0	3
	CN437	Data Security	3	0	0	3
DSE Lab-Elective VIII	CN414	Advanced Data Analytics Lab	0	0	4	2
	CN438	Data security Lab	0	0	4	2
DSE-Elective IX	CN435	Big Data Analytics	3	0	0	3
	CN419	Image Processing	3	0	0	3

ANNEXURE C: High Performance Computing

Courses and Labs to be taken from following table in 7th and 8th semester

DSE Electives

	Course Code	Course	L	T	P	C
DSE-Elective V	CN441	Massively Parallel Models of Computation	3	1	0	4
DSE Lab-Elective V	CN442	Massively Parallel Models of Computation Lab	0	0	4	2
DSE-Elective VI	CN431	Cloud Computing	3	1	0	4
DSE Lab-Elective VI	CN432	Cloud Computing Lab	0	0	4	2
DSE-Elective VII	CN439	Advanced Computer Architecture	3	1	0	4
DSE-Elective VIII	CN443	High Performance Cluster Computing	3	0	0	3
	CN445	Grid Computing	3	0	0	3
	CN447	Introduction to Quantum Computing	3	0	0	3
DSE Lab-Elective VIII	CN444	Cluster Computing Lab	0	0	4	2
	CN446	Grid Computing Lab	0	0	4	2
	CN448	Quantum Computing Lab	0	0	4	2
DSE-Elective IX	CN449	Parallel Algorithm and Computation	3	0	0	3
	CN451	High-Performance Big Data Computing	3	0	0	3

SYLLABUS

SEMESTER I

Course Code	**: PR001**
Course Title	**: ELEMENTARY MATHEMATICS**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 0 L:3 T:0	**P:0**
Class schedule per week	**:03**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understanding cartesian system, appropriate designing of basic curves.
B.	Matrix operations, Linear system and their solutions.
C.	Working with simple Finite series and Elementary statistics.
D.	How to find derivatives of different functions, chain rules and basic understanding of maxima and minima.
E.	Introduction to integral calculus, integration rules and definite integrals etc.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Find distance between points, able to draw the basic curves.
CO2	Understand linear system of equations and Gauss elimination method.
CO3	Understanding Trigonometry and statistics and able to Solve related Problems.
CO4	Find the solutions through differentiations, concept of extreme points and to obtain the functional value on the point.
CO5	Understand how to integrate different algebraic and trigonometric functions.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Elementary Geometry** Point, Location of point, line, Slope of line, Two-point equation, Intercept form of line, Cartesian system, Basic curves-Circle and Parabola.	**8**
Module 2 **Matrix** Matrix Operation – addition, subtraction, product, Idea of determinant, Inverse of Matrix, Linear system of equations, solution of linear system, rank of matrix.	**8**
Module 3 **Series and Statistics** Arithmetic Progression, Geometric Progression, Infinite Geometric Progression, Binomial Expansion. Mean, mode, median, deviation, Standard deviation.	**8**

Module 4 **Elementary Differential Calculus** Basics of Functions, Differentiation of functions, Rules of derivatives, addition and subtraction, product rule, Quotient rule, chain rule. Maxima and Minima.	**8**
Module 5 **Elementary Integral Calculus** Integration, Rules of integration, integration of constant, Integration of Variable. Integration of Square, Integration of Reciprocal, Integration of Exponential function, Integration of Trigonometric Function, Definite integrals.	**8**

TEXT BOOKS:

1. Thomas George B., “THOMAS’ CALCULUS-early Transcendental” Thirteenth edition, Pearson, ISBN 978-0-321-88407-7
2. R. D. Sharma. Mathematics, Part I (Vol. I & II) and Part II (Vol. I & II), Dhanpat Rai Publication.

REFERENCE BOOKS:

1. K. C. Sinha. A Textbook of Mathematics, Rastogi Publications; 13th Edition: 2019 -2020.
2. M. N. Mukherjee, P. Mukhopadhyay, S. Sinha Roy and U. Dasgupta. Rudiments of Mathematics, Parul Prakashani Pvt. Ltd.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	1	1	1	2	1	1	1	1	2	2	2	1	1	1
CO2	2	2	2	1	2	1	1	1	1	1	2	2	1	1	1
CO3	2	3	3	1	3	1	1	1	1	1	2	3	3	1	1
CO4	2	2	2	3	3	1	1	1	2	1	3	3	3	2	1
CO5	2	2	3	2	3	1	1	1	3	2	3	3	3	2	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN101**
Course Title	**: PROGRAMMING AND PROBLEM-SOLVING USING C**
Pre-requisite(s)	**:**
Co- requisite(s)	**: C Lab**
Credits: 3 L: 3 T: 0	**P: 0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the fundamentals of C programming.
B.	Learn about different problems and the approach to solve them.
C.	Gain proficiency with the fundamental concepts of the C programming language.
D.	Be able to apply these concepts to solve real world problems.
E.	Able to program in C programming for a given application.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Choose the loops and decision-making statements to solve the problem.
CO2	Implement different Operations on arrays.
CO3	Use functions to solve the given problem.
CO4	Understand pointers, structures and unions.
CO5	Implement file Operations in C programming for a given application.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Problem Solving and Programming Concepts:** Problem Solving in Everyday Life, Types of Problem, Problem Solving with Computers, General Problem-Solving Strategies. **Overview of C:** History of C, Importance of C, Structure of C program, Sample of C programs. Constant, Variable and Data types: C Tokens – keywords, identifier, constant, string, and operators, and symbols, Data types – primary data types, user defined data types, and derived data types, Declaration of variables, assign values to variables. **Operators and Expressions:** Different types of operators – arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, bitwise operators, conditional operators and special operators, Arithmetic expressions –precedence of arithmetic operators, Type conversions in expressions.	**10**

Managing input and output operations: Reading a character, Writing a character, Formatted input, and Formatted output.	
Module 2 **Decision making and Branching:** Decision making with if statement - Simple if statement, The if …. else statement, Nesting of if …. else statement, The else if ladder, The switch statement, The ?: Operator, The go-to statement. **Decision making and Looping:** The while statement, The do statement, The for statement, Nesting of loops, Jumps in loops: break, continue.	**8**
Module 3 **Arrays:** One - dimensional arrays, Declaration and assign value of one – dimensional arrays, Two dimensional arrays, Declaration and assign value of two – dimensional arrays, Multi – dimensional arrays. **Character Arrays and String:** Declaring and initializing string variables, Reading string from terminal, Writing string to screen, Putting string together, Comparison of two strings, String handling functions, Other features of strings.	**7**
Module 4 **User defined functions:** A multi – function program, Definition of function, Function calls, Function declaration, Category of functions, Nesting of functions, Recursion, Passing arrays to functions, Passing strings to functions. **Standard Library function:** math, date and time.	**8**
Module 5 **Structures and Unions:** Defining a structure, declaring structure variables, Accessing structure members, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Union. **Pointers:** Understanding pointers, Accessing the address of a variable, Declaring pointer variables, Pointer expressions, Array of pointers, Pointers to function, Pointers and structures. **File Management:** Defining and opening a file, Closing a file, Input/ Output operations on files, Error handling during I/O operations.	**7**

TEXT BOOKS:

1. Balagurusamy E., "Programming in ANSI C", 5th Edition, TMH, 2010.
2. Sprankle M., "Problem Solving and Programming Concepts", 7th Edition, Pearson Education, New Delhi, 2006.

REFERENCE BOOKS:

1. Gottfried B. S., "Programming with C", Schaum Series, McGraw Hill, 2005.
2. Kanetkar Y., "Let us C", 4th Edition, BPB publication, New Delhi, 2002.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1				2	2	3	2
CO2	3	3	3	1	3	1	1	1				2	2	2	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

CorrelationLevels1,2or3asdefinedbelow:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN103**
Course Title : **PROGRAMMING AND PROBLEM-SOLVING USING C++**
Pre-requisite(s) :
Co- requisite(s) : **C++ Lab**
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **I/1**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the basic tenets of OOP.
B.	The course will exemplify the basic syntax and constructs of C++.
C.	Understand the application OOP principles in various use cases.
D.	Explain basic C++ characteristics and their working.
E.	The course aims to expose students to newer C++ constructs.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Identify the difference between procedural and OO programming.
CO2	Construct programs using various OOP principles.
CO3	Design programs using C++.
CO4	Operate on files and strings in real life scenarios.
CO5	Analyze the difference between procedural language and OOP.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction to Object Oriented Programming:** Basic concept of OOP, Comparison of Procedural Programming and OOP, Benefits of OOP, C++ compilation, Abstraction, Encapsulation, Inheritance, Polymorphism, Difference betweenC and C++. **Elements of C++ Language:** Tokens and identifiers: Character set and symbols, Keywords, C++ identifiers; Variables and Constants: Integer, character and symbolic constants; Dynamic initialization of variables, Reference variables, Basic data types in C++, Streams in C++.	**6**
Module 2 **Operators and Manipulators:** Operators, Types of operators in C++, Precedence and associativity of operators, Manipulators. **Decision and Control Structures:** if statement, if-else statement, switch statement, Loop: while, do-while, for; Jump statements:break, continue.	**6**
Module 3	

Arrays: One - dimensional arrays, Declaration of one – dimensional arrays, Two – dimensional arrays, Declaration of two – dimensional arrays, Multi – dimensional arrays. **Functions:** Components of function: prototype, function call, definition, parameter; passing arguments; types of function, inline function, function overloading. **Introduction to Classes and Objects:** Classes in C++, class declaration, declaring objects, Defining Member functions, Inline member function, Array of objects, Objects as function argument, Static data member and member function, Friend function and friend class.	**9**
Module 4 **Structures and Unions**: Defining a structure, declaring structure variables, Accessing structure members, Arrays of structures, Arrays within structures, Structures within structures, Structures and functions, Union. **Pointers:** Understanding pointers, Accessing the address of a variable, Declaring pointer variables. **Constructors and Destructors:** Constructors, Instantiation of objects, Default constructor, Parameterized constructor, Copy constructor and its use, Destructors, Constraints on constructors and destructors, Dynamic initialization of objects.	**9**
Module 5 **Inheritance:** Derived class and base class: Defining a derived class, Accessing the base class member, Inheritance: multilevel, multiple, hierarchical, hybrid; Virtual base class, Abstract class. **Virtual Functions and Polymorphism:** Virtual functions, pure virtual functions; Polymorphism, Categorization of polymorphism techniques: Compile time polymorphism, Run time polymorphism. **File Handling:** File classes, Opening and Closing a file, File modes, Manipulation of file pointers, Functions for I/O operations.	**10**

TEXT BOOKS:

1. Balagurusamy E., "Object-Oriented Programming with C++", 4th Edition, TMH, 2008.

REFERENCE BOOKS:

1. Cohoon J.P. & Davidson J.W., "C++ Program Design: An Introduction to Programming andObject-Oriented Design", 2nd Edition, TMH Education, New Delhi, 2000.
2. Friedman F.L. & Koffman E.B., "Problem Solving, Abstraction, and Design Using C++", 4th Edition, Pearson Education, Inc. 2004.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design: Template, GUI Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	2	2	3	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	3	3	2	2	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	2	3	2
CO4	3	3	3	1	3		1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN105**
Course Title	**: BASICS OF OPERATING SYSTEMS**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits:2 L:2 T:0	**P:0**
Class schedule per week	**: 02**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	To understand the key concepts and principles of operating systems.
B.	To explore the design of key components of OS.
C.	To develop the skills necessary to understand the basics of processes, memory and files in any OS.
D.	To analyze and evaluate different OS interfaces.
E.	To apply theoretical knowledge to solve practical problems related to OS.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the key components and functions of an OS.
CO2	Understand the core concepts of process management. Analyze and compare different process scheduling algorithms.
CO3	Understand process deadlock.
CO4	Understand basics of memory management schemes.
CO5	Understand basics of file management schemes.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1: Overview of OS, Evolution and history of OS, Types of OS, Functions and services provided by OS; OS Structure.	**4**
Module 2: Process concept, Process states and process life cycle, Process Control Block, Process scheduling algorithms: First come first served (FCFS), Shortest job first (SJF), Round robin (RR) and Priority-based scheduling.	**8**
Module 3: Deadlock characterization, Deadlock handling methods, deadlock prevention, deadlock avoidance.	**6**
Module 4: Introduction to memory hierarchy, Primary and secondary memory, Contiguous and non-contiguous memory allocation, Fragmentation, Paging.	**6**

Module 5: File concept, File access methods, Directory structure, File protection, File allocation methods.	**6**

TEXT BOOKS:

1. Silberschatz A., Galvin P.B. & Gagne G., "Operating System Concepts", 10^{th} Edition (or later), Wiley India, 2018 (or later).

REFERENCE BOOKS:

1. D.M. Dhamdhere, Operating Systems: A concept Based Approach", Tata McGraw Hill 2^{nd} Edition
2. Tanenbaum, "Operating Systems Design and Implementation", 3rd Edition., Prentice-Hall Inc., 2006

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (PO)												Program Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	3	3	3	2	1	1	2
CO2	3	1	1	1	1	3	1	1	3	1	1	1	1	3	1
CO3	2	3	3	1	2	1	2	2	2	3	3	1	2	1	2
CO4	1	1	3	3	1	1	1	1	1	1	3	3	1	1	1
CO5	3	3	3	1	2	1	1	2	3	3	3	1	2	1	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5, CD8, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN107**
Course Title : **FUNDAMENTALS OF COMPUTER SCIENCE**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 2 L: 2 T: 0 P: 0
Class schedule per week : **02**
Class : **BCA**
Semester / Level : **I/1**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand working of Computer, software and hardware.
B.	Understand basics of operating system and programming languages.
C.	Understand number systems and Boolean algebra.
D.	Understand different computer devices.
E.	Understand the concept of computer memory.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Learn the basics of computer, its software and hardware.
CO2	Describe the concepts of operating system and programming languages.
CO3	Explain number systems and Boolean algebra.
CO4	Describe various input and output devices.
CO5	Describe different memories.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 Introduction to Computers: Definition, Characteristics of Computers, Classification of Computers, Applications of Computers. Computer Software: Software: Definition, Relationship between Software and Hardware, Software Categories, System Software, Application Software.	**5**
Module 2 Operating system: Definition of Operating system, Evolution of operating system, Types of Operating System, Functions of an Operating System, Modern Operating Systems. Computer Program & Languages: Introduction, Developing a program, Algorithm, Flowchart, Pseudo Code (P-Code). Generations of Programming Languages.	**6**
Module 3 Number Systems and Logic Gates: Number Systems, Conversion between Number bases, Arithmetic System. Signed and Unsigned Numbers, Concept of Overflow, Binary Coding, Logic Gates, Boolean Algebra and Combination of Logic Gates.	**7**

Module 4 Input Devices & Output Devices: Keyboard, Pointing Devices, Digital Camera, Scanners, Optical Scanners, output devices: Printers, Plotters, Monitors, Audio output, Projectors, Terminals.	**5**
Module 5 Computer Architecture: Central Processing Unit (CPU), Memory, Communication between various units of a Computer System, The Instruction Format, Instruction Set, Computer Memory: Primary Memory Hierarchy, Random Access Memory, Types of RAM, Read only memory (ROM), Types of ROM., Classification of Secondary Storage Devices, Magnetic Tape, Magnetic Disk, Optical Disk.	**7**

TEXT BOOKS:

1. ITL Education Solution Limited, R & D Wing, Introduction to Computer Science, Pearson Education.
2. Mano M., "Computer System Architecture", Prentice Hall of India, New Delhi,

REFERENCE BOOKS:

1. Raja Raman V, Fundamentals of Computers, Second Edition, PHI, New Delhi.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	1	1	2	2	2	2
CO3	3	3	3	3	3	1	2	2	1	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN109**
Course Title : **ENVIRONMENTAL SCIENCE**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 2 L: 2 T:0 P:0
Class schedule per week :**02**
Class : **BCA**
Semester / Level : **I/1**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Develop basic knowledge of ecological principles and their applications in environment.
B.	Identify the structure and composition of the spheres of the earth, the only planet sustaining life.
C.	Analyze how the environment is getting contaminated and probable control mechanisms for them.
D.	Generate awareness and become a sensitive citizen towards the changing environment.
E.	Understand and practice various preventive measures of environmental pollution.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Explain the structure and function of ecosystems and their importance in the holistic environment.
CO2	Identify the sources, causes, impacts and control of air pollution.
CO3	Distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms.
CO4	Judge the importance of soil, causes of contamination and need of solid waste management.
CO5	Predict the sources of radiation hazards and pros and cons of noise pollution.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Ecosystem and Environment: Concepts of Ecology and Environmental science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management, fate of environmental pollutants, environmental status and reports on climate change.	**6**
Module 2 Air Pollution: Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, control methods and equipment for air pollution control, vehicular emissions and control, indoor air pollution, air pollution episodes and case studies.	**6**

Module 3 Water Pollution: Water Resource; Water Pollution: types and Sources of Pollutants; effects of water pollution; Water quality monitoring, various water quality indices, water and waste water treatment: primary, secondary and tertiary treatment, advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal.	**6**
Module 4 Soil Pollution and Solid Waste Management: Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis.	**6**
Module 5 Noise pollution & Radioactive pollution: Noise pollution: introduction, sources: Point, line and area sources; outdoor and indoor noise propagation, Effects of noise on health, criteria noise standards and limit values, Noise measurement techniques and analysis, prevention of noise pollution; Radioactive pollution: introduction, sources, classification, health and safety aspects, Hazards associated with nuclear reactors and disposal of spent fuel rods-safe guards from exposure to radiations, international regulation, Management of radioactive wastes.	**6**

TEXT BOOKS:

1. A, K. De., "Environmental Chemistry", New Age Publications India Ltd., 3rd Edition, 2008.
2. R. Rajagopalan, "Environmental Studies: From Crisis to Future", 3rd Edition, Oxford University Press, 2016.
3. Eugene P. Odum., "Fundamentals of Ecology", 3rd Edition, WB Sunders Company, Philadelphia, 1971.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin, "Chemistry for Environmental Engineering and Science", John Henry Press, 2002.
5. S.C. Santra, "Environmental Science", New Central Book Agency, 2011.

REFERENCE BOOKS:

1. D.W. Conell, "Basic Concepts of Environmental Chemistry", CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G., "Environmental Engineering", Mc-Graw - Hill International.
3. G.M. Masters & Wendell Ela, "Introduction to Environmental Engineering and Science", PHI Publishers, 1991.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Explain the structure and function of ecosystems and their importance in the holistic environment.
2. Identify the sources, causes, impacts and control of air pollution.
3. Distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design - 3, 4, 12, 13, 14

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1															
CO2	3	3	3	1	3	1	1	1				2			
CO3	3	3	3	1	3	1	1	1				2			
CO4	3	3	3	3	3	1	2	2		1	1	2			
CO5	3	3	3	3	1		1	1		1	1	2			

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN111**
Course Title	**: OFFICE AUTOMATION TOOLS**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 3 L: 2 T: 0	**P: 2**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Use file mangers, word processors, spreadsheets, presentation software's.
B.	Understand the dynamics of an office environment.
C.	Present conclusions effectively, orally and in writing.
D.	Demonstrate the ability to apply application software in an office environment.
E.	To know the practical application of various automation tools.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Use file mangers, word processors, spreadsheets, presentation software's.
CO2	Describe the features and functions of the categories of application software.
CO3	Understand the dynamics of an office environment.
CO4	To apply different tools for different automation problems.
CO5	Use Google Suite for office data management tasks.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Basics of Computer**: Introduction of Computer, Computer generations, Types of Computer, Characteristics of Computer, Fundamental understanding of Computer Storage Device, Input Device, Output Device, Types of Software, Usage of Computer. **Windows Operating system:** Introduction to Windows, Starting Windows, Desk Top, Task Bar, Start Up Menu Working with programs and icons-Adding, removing, starting and quitting programs and icon. Working with files and folders-creating, deleting, opening, finding, copying, moving and renaming files and folders. Control Panel, setting, My Computer, Recycle bin, My documents, drives. Windows notepad, Accessories and windows Explorer.	**8**
Module 2 **Introduction to open office/MS office/ Libre office** Word Processing: Features, Creating, Saving and Opening Documents in Word, Interface, Toolbars, Ruler, Menus, Keyboard, Shortcut, Editing, Previewing, Printing & Formatting a Document, Advanced Features of MS Word, Find & Replace, Using Thesaurus, Using Auto- Multiple Functions, Mail Merge, Handling Graphics, Tables &	**8**

Charts, Converting a word document into various formats like- Text, Rich Text format, Word perfect, HTML, PDF etc.	
Module 3 **Spreadsheets** Worksheet basics, creating worksheet, entering into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet, Opening and moving around in an existing worksheet, Toolbars and Menus, Keyboard shortcuts, Working with single and multiple workbook, working with formulae & cell referencing, Auto sum, Coping formulae, Absolute & relative addressing, Worksheet with ranges, formatting of worksheet, Previewing & Printing worksheet, Graphs and charts, Database, Creating and Using macros, Multiple worksheets- concepts, creating and using.	**8**
Module 4 **Presentation Tools:** Presentation Tools: Adding and formatting text, pictures, graphic objects, including charts, objects, formatting slides, notes, hand-outs, slide shows, using transitions, animations.	**8**
Module 5 **Online Office Tool** Google Docs Tools: Creating, saving, downloading, sharing files/folders from Google drive, creating and sharing Google docs, import and export docs, creating and sharing Google sheet, import and export Google sheet, Google forms and form responses, creating Google slides to present your ideas.	**8**

List of Programs as Assignments:

Implementation of the above modules in the lab experiments.

TEXT BOOKS:

1. Computer Fundamentals by Pradeep K Sinha
2. Peter Norton: Computing Fundamentals. 6th Edition, McGraw Hill-Osborne,6 edition
3. Working in Microsoft Office – Richard Mansfield – Tata McGraw Hill Education.
4. Microsoft Office 2010 For Dummies By Wallace Wang

REFERENCE BOOKS:

1. **https://gsuite.google.com/leaming-center**

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Introduction to online automation software and application.
2. Multimedia Introduction.

POs met through Gaps in the Syllabus - 1 ,2, 3, 4

Topics beyond syllabus/Advanced topics/Design

1. Online automation, online apps

POs met through Topics beyond syllabus/Advanced topics/Design - 3,5,7,8

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	3	3	2	3	3	3	2	3	2	1	3	2	3	3
CO2	3	3	2	3	2	2	1	1	1	2	3	2	3	2	2
CO3	1	2	3	3	2	3	3	2	3	2	3	2	3	3	3
CO4	2	3	2	3	2	3	3	2	3	2	2	3	2	3	3
CO5	3	2	3	2	3	3	2	3	3	2	3	3	3		3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD8
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD4, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	: **CN113**
Course Title	**: LINUX ADMINISTRATION**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 3 L: 2 T:0	**P: 2**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Explain some of the different distribution of Linux and the reason for open source.
B.	Familiar with Linux commands to manage files and file systems. In-depth knowledge of structure of the Linux operating system.
C.	Learning how to write Shell Scripting with Linux operating system. Gaining knowledge to configure basic Linux network services.
D.	Establish user accounts and permissions.
E.	Understand basics of various OS related concepts, from programmer's point of view, like files, directories, kernel, inodes, processes, signals, etc.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Know about Linux Boot Process and System Logging.
CO2	Know about Linux logs and Linux log files.
CO3	Know about Disk Management: Creating partitions with fdisk File Systems.
CO4	Know about LVM - The Logical Volume Manager.
CO5	Know about User Management, Shell Scripting, Networking with Linux Operating System.

Syllabus

MODULES	**(NO. OF LECTURE HOURS)**
Module 1 About Linux Administration, The Linux Boot Process and System Logging creating Virtual Machine, Installation of Linux Operating System on Virtual Machines, System Login and Linux logs files, Viewing and Editing Files, Linux Permissions File and Directory Permissions.	**6**
Module 2 Creating partitions with fdisk File Systems LVM - The Logical Volume Manager Introduction to the Logical Volume Manager (LVM), LVM: Layers of Abstraction Creating Physical Volumes (PVs), Volume Groups (VGs), and Logical Volumes Extending Volume Groups and Logical Volumes Mirroring Logical Volumes Removing Logical Volumes, Physical Volumes, and Volume Groups Migrating Data from One Storage Device to Another.	**6**

Module 3 User Management: Managing Users and Groups Switching Users, Running Commands, Shell Scripting.	**6**
Module 4 Networking: TCP/IP Networking for Linux System Administrators, Networking - DNS and hostnames, DHCP, Dynamic and Static Addressing, TELNET Configuration, FTP, SAMBA Configuration, NFS Configuration and Network Troubleshooting.	**6**
Module 5 Managing Processes and Jobs, Processes and Job Control, Scheduling Jobs with Cron, Managing Software Installing Software on RPM Based Linux Distros, Printer Installing Process (CUP) on Linux OS.	**6**

List of Programs as Assignments:

1. Install a Linux distribution of your choice on a virtual machine or a spare computer.
2. Create a new user account and set a password for it.
3. Change the hostname of the Linux system.
4. Update the system using the package manager.
5. Install a new software package using the package manager.
6. Create a directory called "Documents" in your home directory.
7. Use the command line to navigate to a specific directory.
8. Create a text file using a text editor and save it to your home directory.
9. Use the "ls" command to list the contents of a directory.
10. Use the "cp" command to make a copy of a file.
11. Use the "rm" command to delete a file.
12. Use the "chmod" command to change the permissions of a file or directory.
13. Create a compressed archive of a directory using the "tar" command.
14. Configure a static IP address for the network interface.
15. Set up a basic firewall rule to allow or block incoming connections.
16. Create a symbolic link from one file to another.

TEXT BOOKS:

1. Linux: The Complete Reference, by Richard Petersen Sixth Edition Mc Graw Hill.

REFERENCE BOOKS:

1. Linux for Beginners: An Introduction to the Linux Operating System and Command Line. E-book
2. Linux Command Line and Shell Scripting Bible by Richard Blum Christine Bresnahan, 2021

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	3	3	2	3	3	3	2	3	2	1	3	2	3	3
CO2	3	3	2	3	2	2	1	1	1	2	3	2	3	2	2
CO3	1	2	3	3	2	3	3	2	3	2	3	2	3	3	3
CO4	2	3	2	3	2	3	3	2	3	2	2	3	2	3	3
CO5	3	2	3	2	3	3	2	3	3	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD8
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD4, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course code : **MT132**
Course title : **Communication Skills I**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 1.5 L:0 T: 0 P: 3
Class schedule per week : **03**
Semester / Level : **I/1**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Demonstrate ability to listen to and comprehend complex speech in English, listen to explanations, descriptions, messages, news stories, opinions, solutions, etc.
B.	Demonstrate ability to speak effectively in English with peers, teachers and others, handle the various speaking situations in their academic and social sphere with confidence.
C.	Demonstrate ability to read and analyse functional texts with confidence; apply critical thinking, analysis and problem-solving skills to the reading material
D.	Demonstrate ability to write messages, personal accounts, critical reviews, short biographies, describe processes, write persuasive essays, etc.
E.	Demonstrate a strong hold on functional grammar which helps them avoid common errors in communication.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Communicate confidently in English with their peers and teachers in the immediate environment and with colleagues, clients, etc. in their future workplaces
CO2	Apply their learning of English to domain subjects and make presentations, posters, write research papers, lab reports, etc with confidence
CO3	Handle communicative situations in their academic like such as conversations, discussions, interviews, presentations, seminars, webinars, etc. with confidence
CO4	Prepare for their future workplaces and their requirements such as handling team huddles, meetings, phone calls, client visits, field visits, inspections, etc.
CO5	Apply critical thinking abilities to analyse problems, brainstorm solutions, handle situations that require persuasive skills, etc.

Module I: Effective Listening
The importance of listening; Listening for descriptions of people; listening for opinions; listening for complaints; Listening to people making, accepting, and declining requests; Listening to news stories; listening to messages and a podcast; Process of Listening, Types of Listening, Barriers to Effective Listening, Listening at different managerial levels.

Listening for information about living abroad; listening to opinions; Listening to complaints; Listening to environmental problems; listening for solutions; Listening to descriptions of important events; listening to regrets and explanations; Listening to explanations; listening for the best solution; Listening to past obstacles and how they were overcome; listening for people's goals for the future.

Module II: Speaking with Confidence

Describing personalities; expressing likes and dislikes; agreeing and disagreeing; complaining; Talking about possible careers; describing jobs; deciding between two jobs; Making direct and indirect requests; accepting and declining requests; Narrating a story; describing events and experiences in the past; Talking about traveling abroad; expressing emotions; describing cultural expectations; giving advice; Describing problems; making complaints; explaining something that needs to be done; Identifying and describing problems; coming up with solutions; Asking about preferences; discussing different skills to be learned; talking about learning methods; talking about life skills; asking for and giving advice or suggestions; talking about things to be accomplished in the future; Describing milestones; describing turning points; describing regrets and hypothetical situations; Describing qualities for success; giving reasons for success; interviewing for a job; talking about ads and slogans; Drawing conclusions; offering explanations; Giving opinions for and against controversial topics; offering a different opinion; agreeing and disagreeing

Module III: Art of Reading

Reading about unusual social networking sites; Reading about different types of workplaces; Reading about talking to friends about difficult topics; Types of Reading, Methods of Reading, Reading Comprehension.

Reading about the reliability of online content; Reading about a problem with a ride-sharing service; Reading about a creative solution to a problem; Reading about different studying styles; Reading about young scientist; Reading about futurists and their predictions for the year 2050; Reading about a conflict and advice on how to fix it; Reading about advertisements; Reading about unexplained events; Reading about a job role; Reading about plagiarism in the digital age

Module IV: Writing Skills

Writing a description of a good friend; Writing about two career choices; Writing a message with requests; Writing a personal account; Writing a pamphlet for tourists; Writing a critical online review; Writing a post on a community website; Writing about a skill; Writing a message of advice; Writing a biography; Writing a message of apology; Writing a TV or web commercial; Writing about a process; Writing a persuasive essay; Writing a personal statement for an application

Module V: Advanced Writing Skills

Art of condensation: Précis writing, Summary, Abstract, Synopsis, Paraphrasing; Paragraph writing; Essay writing: Writing a persuasive essay; Writing a biography; Writing about a process; Writing a personal statement for an application; Writing a critical online review; Writing about a complicated situation; Report writing; Writing technical proposals

TEXT BOOKS:

1. Communication Skills IInd edition, Sanjay Kumar & PushpLata, Oxford University Press
2. Business Correspondence and Report Writing,R.C.Sharma, Krishna Mohan.Mcgraw Hill
3. Communication for Business,Shirley Taylor, V.Chandra, Pearson
4. Basic Business Communication- .Lesikar I Flatley, McGraw Hill.
5. Business Communication Today ,Bovee, Thill and Chatterjee, Pearson

Coursebook: *Interchange 5 edition Level 3,* Jack C. Richards, Jonathan Hull, Susan Proctor, Cambridge University Press

Components: Student's Book with online self-study (print/online bundle)

CEFR level: B1

Course Code	**: CN102**
Course Title	**: C LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Programming and problem-solving using C**
Credits: 2 L: 0 T: 0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: I/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Learn computer language.
B.	Learn coding for problems.
C.	Learn the problem-solving process through computer.
D.	Know the limitations of system during program execution.
E.	Know the practical application of various programming techniques.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Formulate simple algorithms for arithmetic and logical problems.
CO2	Translate the algorithms to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	Decompose a problem into functions and synthesize a complete program using divide and conquer approach.

SYLLABUS

List of Programs as Assignments:

1. Write a program to print HELLO WORLD on screen.
2. Write a program which accept two numbers and print their sum.
3. Write a program which accept temperature in Farenheit and print it in centigrade.
formula C=(F-32)/1.8
4. Write a program which accept principle, rate and time from user and print the simple interest.
5. Write a program which accepts a character and display its ASCII value.
6. Write a program to swap the values of two variables.
7. Write a program to calculate area of circle.
8. Write a program to check whether the given number is positive or negative using ? : ternary operator
9. Write a program to check whether the given number is even or odd using ? : ternary operator
10. Write a program which input three numbers and display the largest number.
11. Write a program which accepts days as integer and display total number of years, months and days in it. For example: If user input as 856 days the output should be 2 years 4 months 6 days.
12. Write a program to determine whether the seller has made profit or incurred loss. Also determine how much profit he made or loss he incurred. Cost price and selling price of an item is input by the user.

13. Write a program to determine the youngest of the three, If the ages of Ram, Sulabh and Ajay are input by the user.
14. Write a program to check whether a triangle is valid or not, when the three angles of the triangle are entered by the user. A triangle is valid if the sum of all the three angles is equal to 180 degrees.
15. Write a program to determine whether the year is a leap year or not. Any year is input by the user.
16. In a company an employee is paid as under:
If his basic salary is less than Rs. 1500, then HRA = 10% of basic salary and DA = 90% of basic salary.
If his salary is either equal to or above Rs. 1500, then HRA = Rs. 500 and DA = 98% of basic salary.
If the employee's salary is input by the user write a program to find his gross salary.
17. Write a program to calculate the monthly telephone bills as per the following rule:
Minimum Rs. 200 for upto 100 calls.
Plus Rs. 0.60 per call for next 50 calls.
Plus Rs. 0.50 per call for next 50 calls.
Plus Rs. 0.40 per call for any call beyond 200 calls.
18. WAP to find the roots of quadratic equation of type ax^2+bx+c where a is not equal to zero.
19. The marks obtained by a student in 5 different subjects are input by the user. The student gets a division as per the following rules:
Percentage above or equal to 60 - First division
Percentage between 50 and 59 - Second division
Percentage between 40 and 49 - Third division
Percentage less than 40 - Fail
Write a program to calculate the division obtained by the student.
20. Any character is entered by the user; write a program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol.
21. Write a program to calculate the sum of first 10 natural number.
22. Write a program to find the factorial value of any number entered through the keyboard.
23. Two numbers are entered through the keyboard. Write a program to find the value of one number raised to the power of another.
24. Write a program to reveres any given integer number.
25. Write a program to sum of digits of given integer number.
26. Write a program to check given number is prime or not.
27. Write a program to calculate HCF of Two given number.
28. Write a program to enter the numbers till the user wants and at the end it should display the maximum and minimum number entered.
29. Write a program to print out all Armstrong numbers between 1 and 500. If sum of cubes of each digit of the number is equal to the number itself, then the number is called an Armstrong number.
For example, 153 = (1 * 1 * 1) + (5 * 5 * 5) + (3 * 3 * 3)
30. Write a program to print Fibonacci series of n terms where n is input by user : 0 1 1 2 3 5 8 13 24 ....n
31. Write a program to calculate the sum of following series where n is input by user.
1 + 1/2 + 1/3 + 1/4 + 1/5 +…………1/n
32. Compute the natural logarithm of 2, by adding up to n terms in the series
1 - 1/2 + 1/3 - 1/4 + 1/5 -... 1/n. where n is a positive integer and input by user.
33. Write a program to print following:
i)

```
*
**
***
****
*****
```

ii)

```
    *
   **
  ***
 ****
*****
```

iii)

```
    *
   ***
  *****
 *******
*********
```

iv)

```
    1
   222
  33333
 4444444
555555555
```

v)

```
    1
   212
  32123
 4321234
543212345
```

34. Write a program to compute sinx for given x. The user should supply x and a positive integer n. We compute the sine of x using the series and the computation should use all terms in the series up through the term involving x^n

$\sin x = x - x^3/3! + x^5/5! - x^7/7! + x^9/9!$ ....

35. Write a program to compute the cosine of x. The user should supply x and a positive integer n. We compute the cosine of x using the series and the computation should use all terms in the series up through the term involving x^n

$\cos x = 1 - x^2/2! + x^4/4! - x^6/6!$ .....

36. Write a program which input principal, rate and time from user and calculate compound interest. You can use library function. $CI = P(1+R/100)^T - P$

37. Write a program to compute area of triangle. Sides are input by user.
Area = sqrt(s*(s-a)*(s-b)*(s-c)) where s=(a+b+c)/2.

38. Write a program to find the sum and average of one dimensional integer array.

39. Write a program to reverse the element of an integer 1-D array.

40. Write a program to find the largest and smallest element of an array.

41. Write a menu driven program to do following operation on two dimensional array A of size m x n. You should use user-defined functions which accept 2-D array A, and its size m and n as arguments. The options are:

- To input elements into matrix of size m x n
- To display elements of matrix of size m x n
- Sum of all elements of matrix of size m x n

- To display row-wise sum of matrix of size m x n
- To display column-wise sum of matrix of size m x n
- To create transpose of matrix B of size n x m

42. Write user defined functions for square matrix to calculate
- Left diagonal sum
- Right diagonal sum

43. Write a user-defined function in C to display the multiplication of row element of two-dimensional array A[4][6] containing integer.
44. Write a program to add and multiply of two 2-D array A and B of size m x n.
45. Write a program to count number of vowels, consonant and words in a given string.
46. Write a program to concatenate and copy one string contents to another.
47. Write a program to compare two strings they are exact equal or not.
48. Write a program to check a string is palindrome or not.
49. Write a program to find a substring within a string. If found display its starting position.
50. Write a program to print reverse string from a given string.
51. Write a program to convert a string in lowercase uppercase and vies-versa.
52. Write a program using function which accept two integers as an argument and return its sum. Call this function from main( ) and print the results in main( ).
53. Write a function to calculate the factorial value of any integer as an argument. Call this function from main( ) and print the results in main( ).
54. Write a function that receives two numbers as an argument and display all prime numbers between these two numbers. Call this function from main( ).
55. Raising a number to a power p is the same as multiplying n by itself p times. Write a function called power that takes two arguments, a double value for n and an int value for p, and return the result as double value. Use default argument of 2 for p, so that if this argument is omitted the number will be squared. Write the main function that gets value from the user to test power function.
56. Write a program that lets the user perform arithmetic operations on two numbers. Your program must be menu driven, allowing the user to select the operation (+, -, *, or /) and input the numbers.Your program must consist of following functions:

a. Function showChoice: This function shows the options to the user and explains how to enter data.
b. Function add: This function accepts two number as arguments and returns sum.
c. Function subtract: This function accepts two number as arguments and returns their difference.
d. Function multiply: This function accepts two number as arguments and returns product.
e. Function divide: This function accepts two number as arguments and returns quotient.

57. Write a menu driven program with following option

a. Accept elements of an array
b. Display elements of an array
c. Sort the array using insertion sort method
d. Sort the array using selection sort method
e. Sort the array using bubble sort method

Write C functions for all options. The functions should have two parameters name of the array and number of elements in the array.

58. P is one-dimensional array of integers. Write a C function to efficiently search for a data VAL from P. If VAL is present in the array then the function should return value 1 and 0 otherwise.
59. Suppose a one-dimensional array AR containing integers is arranged in ascending order. Write a user-defined function in to search for an integer from AR with the help of Binary search method, returning an integer 0 to show absence of the number and integer 1 to show presence of

the number in the array. Function should have three parameters : (i) array AR (ii) the number to be searched and (iii) the number of elements N in the array.

60. Suppose A, B, C are arrays of integers of size M, N, and M + N respectively. The numbers in array A appear in ascending order while the numbers in array B appear in descending order. Write a user defined function in to produce third array C by merging arrays A and B in ascending order. Use A, B and C as arguments in the function.

61. Suppose X. Y, Z are arrays of integers of size M, N, and M + N respectively. The numbers in array X and Y appear in descending order. Write a user-defined function in to produce third array Z by merging arrays X and Y in descending order.

62. Declare a structure to represent a complex number (a number having a real part and imaginary part). Write functions to add, subtract, multiply and divide two complex numbers.

63. Write a recursive function to print the factorial of given n number. Implement the function in a complete C program.

64. Write a recursive function to print the Fibonacci series of given number.

65. Write a recursive function to calculate S = 2 + 4 + 6 + 8 + …… + N.

66. An array stores details of 25 students (rollno, name, marks in three subject). Write a program to create such an array and print out a list of students who have failed in more than one subject.

67. Create records of 60 students, where each record has fields-name, roll, gpa and fees. Write a function update () to reduce the fees of those students who have obtained gpa greater than 8.5 by 25% of the original fees. Write a complete program to exercise this function in the main program and display all the records before and after updation.

68. Define a strucutre student with the following specification

admno	integer
sname	20 character
eng. math, science	float
total	float

90. Define a structure batsman with the following specifications:

bcode	4 digits code number
bname	20 characters
innings, notout, runs	integer type
batavg	it is calculated according to the formula – batavg =runs/(innings-notout)
calcavg()	Function to compute batavg

69. Define a structure that describes a hotel. It should have members that include the name, address, grade, average room charge and number of rooms. Write a function to perform the following operations:

a) To print out hotels of a given grade in order of charges.

b) To print out hotels with room charges less than a given value.

70. Write a function that accepts two arguments an array and its size n. It performs Bubble up sort on the array elements. Using indirection operator '*' implement this in a complete C program. Display the source and the sorted array.

71. Using pointer, write a function that receives a character string and a character as argument. Delete all occurrences of this character in the string. The function should return corrected string with no holes.

72. Write a function for reading character string using pointer. Calculate the length of the string (without using strlen ()). Finally print the string in reverse order, using pointer.

73. WAP to sort a list of strings into alphabetical order using array of pointers.

74. WAP to concatenate the contents of two files into a third file.

75. WAP to copy the content of one file into another file. Names of both the files are to be input as command line arguments.

TEXT BOOKS:

1. Jery R Hanly, "Problem solving and Program design in C", Pearson Education, 7th Edition.
2. Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill.

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall India Learning Private Limited.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. R. G. Dromey, How to Solve it by Computer, Pearson Education.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN104**
Course Title : **C++ LAB**
Pre-requisite(s) :
Co- requisite(s) : **Programming and problem-solving using C++**
Credits: 2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **I/1**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn computer language.
B.	Learn coding for problems.
C.	Learn the problem-solving process through computer.
D.	Know the limitations of system during program execution.
E.	Know the practical application of various programming techniques.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Formulate simple algorithms for arithmetic and logical problems.
CO2	Translate the algorithms to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO5	Decompose a problem into functions and synthesize a complete program using divide and conquer approach.

SYLLABUS

List of Programs as Assignments:

1. Write a program to read two numbers from the keyboard and display the larger value on the screen.
2 Write a program to input an integer value from keyboard and display on screen
"WELL DONE" that many times.
3.Write a program to display the following output using a single "cout" statement
Maths = 90
Physics = 77
Chemistry = 69
4. Write a program to read two numbers from the keyboard and display the larger value on the screen
5. Write a program to read the values a, b and c and display x, where x = a / b –c.
6. Write a C++ program that will ask for a temperature in Fahrenheit and display it in Celsius
7. Write a function using reference variables as arguments to swap the values of a pair of integers.
8. Write a program to evaluate the following investment equation $V = P(1+r)^n$
9. An election is contested by five candidates. The candidates are numbered 1 to 5 and the voting is done by marking the candidate number on the ballot paper. Write a program to read the ballots and count the vote cast for each candidate using an array variable count. In case, a number read is outside

the range 1 to 5, the ballot should be considered as a “spoilt ballot” and the program should also count the numbers of “spoilt ballots”

10. A cricket has the following table of batting figure for a series of test matches: Player’s name, Run, Innings, Time not out. “Sachin” “8430”, “230” ,”18”; “Saurav” “4200”, “130”, “9” ; “Rahul”, “3350”, “105”, “11”;. . . .. Write a program to read the figures, set out in the above forms, to calculate the batting arranges and to print out the complete table including the averages.

11. An electricity board charges the following rates to domestic users to discourage large consumption of energy: For the first 100 units – 60P per unit For the first 200 units – 80P per unit For the first 300 units – 90P per unit All users are charged a minimum of Rs. 50.00. If the total amount is more than Rs. 300.00 then an additional surcharge of 15% is added. Write a program to read the names of users and number of units consumed and print out the charges with names

12. Write a program to read a matrix of size m*n from the keyboard and display the same on the screen using function.

13. Write a function power() to raise a number m to power n. The function takes a double value for m and int value for n and returns the result correctly. Use a default value of 2 for n to make the function to calculate the squares when this argument is omitted. Write a main that gets the values of m and n from the user to test the function.

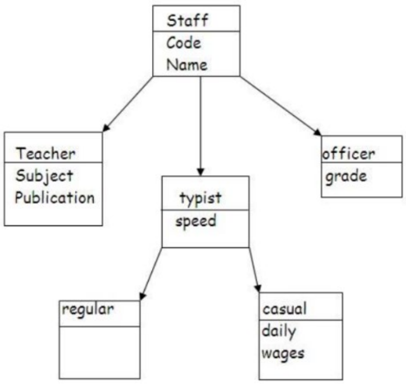
14. Write a function power() to raise a number m to power n. The function takes a double value for m and int value for n and returns the result correctly. Use a default value of 2 for n to make the function to calculate the squares when this argument is omitted. Write a main that gets the values of m and n from the user to test the function

15. Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

16. Wite a function to obtain maximum among thee numbers.

17. Assume that a bank maintains two kinds of accounts for customers, one called as savings and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level a service charge is imposed. Create a class account that stores customer name, account number and type of account. From this derive the classes cur_acct and sav_acct to make them more specific to their requirements. Include necessary member functions in order to achieve the following tasks: (a) Accept the deposit from a customer and update the balance. (b) Display the balance. (c) Compute and deposit interest. (d) Permit withdrawal and update the balance. (e) Check for the minimum balance, impose penalty, necessary and update the balance. Do not use any constructors. Use member functions to initialize class member.

19. An educational institution wishes to maintain a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown in following figure. The figure also shows the minimum information required for each class. Specify all classes and define functions to create the database and retrieve individual information as and when required.



20. The database created in exercise 19 does not include educational information of the staff. It has been decided to add this information to teachers and officers (and not for typists) which will help management in decision making with regard to training, promotions etc. Add another data class called education that holds two pieces of educational information namely highest qualification in general education and highest professional qualification. This class should be inherited by the classes teacher and officer. Modify the program of exercise 19 to incorporate these additions
21 Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data() to initialize base class data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements.
22. Write a program to read a list containing item name, item code, and cost interactively and produce a three column output as shown below.

Name	Code	Cost
Turbo C++	1001	250.95
C primer	905	95.70
………………	…………	……………

……………… ………… ……………

23. Modify the above program(Q. 22) to fill the unused spaces with hyphens.

TEXT BOOKS:

1. Balagurusamy E., "Object-Oriented Programming with C++", 4th Edition, TMH, 2008.

REFERENCE BOOKS:

1. Cohoon J.P. & Davidson J.W., "C++ Program Design: An Introduction to Programming andObject-Oriented Design", 2nd Edition, TMH Education, New Delhi, 2000.
2. Friedman F.L. & Koffman E.B., "Problem Solving, Abstraction, and Design Using C++", 4thEdition, Pearson Education, Inc. 2004.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	3	2	2	2	2	2	2
CO2	3	3	3	1	3	1	1	1	1	3	2	2	2	3	2
CO3	3	3	3	3	3	1	2	2	1	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	2	1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

SEMESTER II

Course Code	**: CN121**
Course Title	**: INTRODUCTION TO DATA STRUCTURES**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Data Structures Lab**
Credits:4 L:3 T: 1	**P: 0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: II/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Know details about the data structure.
B.	Applications, advantages and limitations of various data structures.
C.	Real life use of various data structures.
D.	Implementations of various data structures.
E.	Analyze and compare the different algorithms.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Analyze and compare the efficiency of algorithms and understanding the properties of various data structures.
CO2	Apply data structures in the modelling of computer-based systems in a way that demonstrates comprehension of the trade-offs involved in design.
CO3	Demonstrate the usage of optimal trees.
CO4	Identifying one of many sorting and searching algorithms and implementing the same for real life applications.
CO5	Develop solutions for real life problems using graph-based algorithms.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Introduction to Algorithmic, Asymptotic notations, Complexity- Time-Space Trade off. Data Structure-Definition and classification. **Arrays:** Representation of Arrays in Memory: Accessing of elements of array, performing operations like Insertion, Deletion, arranging elements and searching, applications of arrays. **Stacks and Queues**: Introduction to data structures like Stacks and Queues. Operations on Stacks and Queues, Array representation of Stacks, Applications of Stacks: Operations of Queues, Representations of Queues, Applications of Queues.	**10**
Module 2 **Linked Lists**: Singly linked lists, Representation of linked list, Operations of Linked list such as Traversing, Insertion and Deletion, Searching, Applications of Linked List. Concepts of Circular linked list and doubly linked list and their Applications, Stacks and Queues as linked list.	**10**

Module 3 **Trees:** Basic Terminology, Binary Trees and their representation, binary search trees, various operations on Binary search trees like traversing, searching, Insertion and Deletion, Applications of Binary search Trees, Complete Binary trees, AVL trees, Threaded Binary trees, m-way search trees, B-Trees.	**8**
Module 4: **Searching and Sorting**: Definition. Linear Search, Binary search, Interpolation Search, Transpose Sequential Search. Insertion Sort, Selection sort, Quick sort, Merge sort, Heap sort.	**6**
Module 5 **Graphs:** Terminology and Representations, Adjacency Matrix and Adjacency List Representation, Directed Graphs and Undirected Graphs and their Transversal – DFS &BFS.	**6**

TEXT BOOKS:

1. Horowitz and Sahni, "Fundamentals of Data structures", Galgotia publications.
2. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", Tata McGraw-Hill.

REFERENCE BOOKS:

1. Tannenbaum, "Data Structures", PHI.
2. Lipschutz Seymour, "Data Structures", Tata McGraw-Hill.
3. Drozdek Adam, "Data Structures and Algorithms in C++", Thomson Learning.
4. R.L. Kruse, B.P. Leary, C.L. Tondo, "Data structure and program design in C", PHI,
5. Michael T. Goodrich, "Data Structures and Algorithms in C++", Wiley India Edition.
6. Tremblay J. P., Sorenson P. G, "An Introduction to Data Structures with Applications", McGraw-Hill.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	2	2	2	2	3	3	3	3	1	2	2
CO2	3	3	3	2	2	3	2	1	3	2	3	3	3	2	3
CO3	3	3	3	3	2	2	2	2	2	2	3	3	2	2	3
CO4	2	2	2	3	1	2	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	3	3	3	3	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code		**: CN123**
Course Title		**: BASICS OF DIGITAL COMPUTER AND LOGIC DESIGN**
Pre-requisite(s)		**:**
Co- requisite(s)		**:**
Credits:4 L:3	**T:1**	**P:0**
Class schedule per week		**: 04**
Class		**: BCA**
Semester / Level		**: II/1**
Branch		**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
B.	Identify the number of variables and their simplification importance and understand different circuits for the implementation of Boolean equations.
C	Understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
D.	Implement and design simple logical operations using combinational logic circuits and sequential logic circuits.
E.	Implement synchronous state machines using flip-flops.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Manipulate numeric information in different forms.
CO2	Manipulate simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
CO3	Minimize the circuit diagrams by use of K-Map concepts and Boolean Algebra.
CO4	Design and analyze the outcome of the circuit designed.
CO5	Design and analyze sequential circuits and to use standard sequential functions to build larger more complex circuits.

Syllabus

Module	**(NO. OF LECTURE HOURS)**
Module 1 **Number System and Boolean Algebra**: Digital Systems, Binary Numbers, Number Base Conversion Methods, Complements of Numbers, Signed Binary Numbers, Binary Codes, Binary Coded Decimal Code, Gray Codes, ASCII Character Code, Error Detecting Codes. Boolean Algebra, Axiomatic Definition of Boolean Algebra, Basic theorems and properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Digital Logic Gates, Properties of XOR Gates, Universal Gates.	**10**
Module 2 **Minimization Techniques**: Introduction, The minimization with theorems, The Karnaugh Map Method, Three, Four and Five variable K- Maps, Prime and Essential	**10**

Implications, Product of Sums Simplification, Don't Care Conditions, NAND and NOR Implementation, Multilevel NAND/NOR realizations.	
Module 3 **Combinational Circuits**: Design Procedure – Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Binary Adder, Parallel binary subtractor, Binary Multiplier, Multiplexers/De-Multiplexers, decoder, Encoder, Code Converters, Magnitude Comparator.	**10**
Module 4 **Sequential Circuits**: Introduction, Basic Architectural Distinctions between Combinational and Sequential circuits, Latches, The S-R-Latch Flip-Flop The D-Latch, Flip-Flops, SR, JK, D, T and Master slave, characteristic Tables and equations, Conversion from one type of Flip-Flop to another, Analysis of clocked sequential circuits, Register and Counters: Registers, Shift Register, Ripple Counter, Synchronous Counters.	**10**
Module 5 **Memory Devices**: Classification of memories – ROM: ROM organization, PROM, EPROM, EEPROM, RAM: RAM organization, Write operation, Read operation, Static RAM, Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic, Implementation of Combinational Logic circuits using ROM, PLA, PAL.	**10**

TEXT BOOKS:

1. Digital Design- Morris Mano, PHI, 3rd Edition.

REFERENCE BOOKS:

1. Computer System Architecture- Morris Mano, PHI, 3rd Edition
2. Switching Theory and Logic Design-A. Anand Kumar, PHI, 2nd Edition.
3. Fundamentals of Logic Design- Charles H. Roth, Cengage Learning, 5th, Edition, 2004

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	2	1	2	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	1	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	3	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	2	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CO4 CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN131**
Course Title	**: MATHEMATICS FOR COMPUTING I**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester/Level	**: II/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Use appropriate set, function, or relation models to analyse practical examples, interpret the associated operations and terminology in context.
B.	Meaning and application of Counting Problems and uses.
C.	Use Pictorial Representation (Graphs) to model Problems and find solution.
D.	Understand Abstract structure of mathematics which help student understand Modular Mathematics algebra, Cryptography etc.
E.	Solving Problems using Mathematical Methods.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Familiarity with Different Terminologies used in Mathematics and Computing.
CO2	Understand and Formulate the Problem.
CO3	Understanding Mathematics and its ways for Solving a Problem.
CO4	Analyze to solve Problem using Mathematical Methods.
CO5	Solve the Problems applying Methods.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Sets and Functions** Set, Subset, Set Operations, Properties of Set operations, Functions, properties of Functions, Composite of functions, Inverse of Function. Trigonometric Functions, Exponential and Log function, Greatest integer and least Integer function.	**10**
Module 2 **Relations** Relations on a Set, Properties of relations, Closures of Relation, Equivalence Relation, Partial ordered Relation, Hasse Diagram, Effect of Relations of the Set.	**10**
Module 3 **Counting and Recurrence relation** Basics of Counting, Permutation, Combination, Pigeonhole Principle, Solving	**10**

Recurrence relation using Backtracking and Characteristic equation roots Method.	
Module 4 **Graph Theory** Terminology of Graphs, Basic Theorems, Digraphs, Path and Cycles, Trees, Connected and Disconnected Graph, Complete Graph, Euler and Hamiltonian Graph, Spanning tree and Minimal Spanning Tree for weighted Graph.	**10**
Module 5 **Algebraic Structure** Semi-Group, Monoid, Group, Sub-Group, Ring and Field.	**10**

TEXT BOOKS:

1. Kolman, B.; Busby, R. and Ross, S.: Discrete Mathematical Structures (6e), Pearson Education India –ISBN 978-9332549593.
2. Narsingh Deo, Graph Theory with application to engineering and computer Application, PHI, ISBN-978-8120301450

REFERENCE BOOKS:

1. Rosen Kenneth H., "Discrete Mathematics and its Applications", 6th edition, McGraw-Hill, ISBN 978-0-07-288008-3.
2. Lipschutz Semyour & Lipson Marc, "Discrete Mathematics", McGraw-Hill, 3rd Special Indian Edition, ISBN-13: 978-0-07-060174-1.

Gaps in the Syllabus (to meet Industry/Profession requirements)

Pos met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	1	1	1	2	1	1	1	1	2	2	2	1	1	1
CO2	2	2	2	1	2	1	1	1	1	1	2	2	1	1	1
CO3	2	3	3	1	3	1	1	1	1	1	2	3	3	1	1
CO4	2	2	2	3	3	1	1	1	2	1	3	3	3	2	1
CO5	2	2	3	2	3	1	1	1	3	2	3	3	3	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	
CD2	Tutorials/Assignments	CO2	
CD3	Seminars	CO3	
CD4	Mini Projects/Projects	CO4	
CD5	Laboratory Experiments/Teaching Aids	CO5	
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CA126**
Course Title	**: MATLAB PROGRAMMING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: II/I**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Present the main components of MATLAB.
B.	Introduce the different mathematical functions available in MATLAB.
C.	Handling different mathematical applications using MATLAB.
D.	Analyze the different techniques for handling real time applications.
E.	Development of simulation using MATLAB.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the general idea about MATLAB software.
CO2	Understand the implementation of different mathematical formulas in MATLAB environment.
CO3	Gain proficiency needed to implement mathematical applications.
CO4	Be familiar with various types of scientific software.
CO5	Get in-depth knowledge of implementations of real time simulation.

Syllabus

List of Programs as Assignments:

1. Solve the following using command window

$$\frac{35.7 \,.\, 64\, 7^3}{45 + 5^2}$$

2. Solve the following using command window

$$\frac{5}{4} \,.\, 7 \,.\, 6^2 + \cdots \frac{3^7}{(9^3 - 652)}$$

3. Invoke MATLAB interactively and perform the following steps.

a) Initialize a variable x to 2.

b) Add 3 to x. Print out the result.

c) Print out the result of x + 1*2 and (x+1)*2. (Observe how parentheses make a difference).

d) What variable type is x?

e) Write a program to Demonstrate by using several values of angle θ that:

$\sin^2(\theta) + \cos^2(\theta)=1$.

4. Given a vector t, write down the MATLAB expressions that will correctly compute the following: a. $\ln(2 + t + t^2)$
    b. $e^t(1 + \cos(3t))$
    c. $\cos^2(t) + \sin^2(t)$
    d. $\tan^{-1}(t)$ (this is the inverse tangent function)
    e. $\cot(t)$
    f. $\sec^2(t) + \cot(t) - 1$
5. Make a plot of x = [0:0.1:20]; y = sin(x);
6. Write a program to Draw the graph that joins the points (0,1), (4,3), (2,0) and (5,-2). 7. Write a program to. create a row of data under the variable name x x=[0 1 2 3 4 5 6 7 8 9 10] add 7 to the data and multiply with 8.
8. Solve the following using command window

$$\frac{3^7 \log(76)}{7^3 - 546} + \sqrt[3]{910}$$

9. Solve the following using command window

$$\cos^2\left(\frac{5\pi}{6}\right) \quad \sin\left(\frac{7\pi}{8}\right)^2 + \frac{\tan\left(\frac{\pi}{6} In8\right)}{\sqrt{7}}$$

10. Consider the following matrix and write a program to find the transpose of A

$$A = \begin{bmatrix} 1 & 1 & 2 \\ 1 & 4 & 5 \\ 2 & 5 & 2 \end{bmatrix}, B = \begin{bmatrix} 3 & 2 \\ 1 & 1 \end{bmatrix}$$

11. Create the following three matrices

$$A = \begin{bmatrix} 5 & 2 & 4 \\ 1 & 7 & -3 \\ 6 & -10 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 11 & 5 & -3 \\ 0 & -12 & 4 \\ 2 & 6 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 7 & 14 & 1 \\ 10 & 3 & -2 \\ 8 & -5 & 9 \end{bmatrix}$$

$$A = \begin{bmatrix} 5 & 2 & 4 \\ 1 & 7 & -3 \\ 6 & -10 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 11 & 5 & -3 \\ 0 & -12 & 4 \\ 2 & 6 & 1 \end{bmatrix} \quad C = \begin{bmatrix} 7 & 14 & 1 \\ 10 & 3 & -2 \\ 8 & -5 & 9 \end{bmatrix}$$

Calculate A + B and B + A to show that addition of matrices is commutative
12. Calculate A + (B+C) and (A+B) + C to show that addition of matrices is associative
13. Calculate 5(A + C) and 5A + 5C to show that, when matrices are multiplied by a scalar, the multiplication is distributive.
14. Write a MATLAB program to find the sum of numbers from 1 to 9.

15. Find and display all integers between 1 and 10000 which divide by 37.

16. Fibonacci numbers form a sequence starting with 0 followed by 1. Each subsequent number is the sum of the previous two. Hence the sequence starts as 0, 1, 1, 2, 3, 5, 8, 13, ... Calculate and display the first 10 even Fibonacci numbers.
17. Calculate A*(B+C) and A*B + A*C to show that matrix multiplication is distributive.
18. Calculate (by writing one command) the radius r of a sphere that has a volume of 350 in^3. Once r is determined, use it to calculate the surface area of the sphere.
19. Write a MATLAB code to Create a new function, that multiply 2 numbers, and use it.
20. Write a function called F to C to convert Fahrenheit temperatures into Celsius.
21. Write a script that generates an array of 6 random numbers between 0 and 10.
22. Plot the function $f(x) = \frac{x^2-x+1}{x^2+x+1} \quad for -10 \le x \le 10 f(x) = \frac{x^2-x+1}{x^2+x+1} \quad for -10 \le x \le 10$

TEXT BOOK:

1. Amos Gilat, "MATLAB An Introduction with Applications", 1st Edition, John Willy & Sons, Inc., 2003

REFRENCE BOOK:

1. Rudra Pratap "Getting started with MATLAB", Oxford; Edition, 2010

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Idea of implementation of Simulation using MATLAB
2. Ideas of implementation of complex mathematical formula

POs met through Gaps in the Syllabus - 1, 2

Topics beyond syllabus/Advanced topics/Design

1. Development of real time simulation
2. Implementation of relational and logical operators.
3. Design of Polynomial and curve fitting.
4. Implementation of Interpolation.

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 4, 12

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	: **CN128**
Course Title	**: LateX Lab**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits:2 L:0 T:0	**P:4**
Class schedule per week	**:04**
Class	**: BCA**
Semester / Level	**: II/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand LaTeX, a document preparation system for high - quality typesetting.
B.	Understand features of LaTeX.
C.	Have hands on experience to become a user of LaTeX.
D.	Prepare a Latex document, to make scientific article and project report.
E.	Make students know importance of this software for publishing research articles, papers, project reports and books and thereby help them to be comfortable with the software.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Typesetting of complex mathematical formulae using LaTeX.
CO2	Use tabular and array environments within LaTeX.
CO3	Use various methods to either create or import graphics into a LaTeX document.
CO4	Typesetting of journal articles, technical reports, thesis, books, and slide presentations.
CO5	Automatic generation of table of contents, bibliographies and indexes.

Syllabus

List of Programs as Assignments:
1. Installation of MikeTeX (LateX).
2. Implementation of Class and packages.
3. Implementation of Latex programming and commands, sample packages.
4. Implementation of different commands.
5. Implementation of Sample Document.
6. Implementation of Document structure.
7. Implementation of Font, space.
8. Implementation of Margin Notes.
9. Implementation of modifying character appearance.
10. Implementation of Colored text.
11. Implementation of different Lists.
12. Implementation of inserting images.
13. Implementation of different Mathematical environments, math mode, mathematical symbols.
14. Implementation of creating different table.
15. Implementation of Footnote.
16. Implementation of Page Margins Adjustment.

17. Implementation of Page Border.
18. Implementation of Line between columns for two column documents.
19. Implementation of creating **slides, adding frames.**
20. Implementation of Table of contents, bibliography, and index.

TEXT BOOKS:

1. Guide to LATEX, Helmut Kopka, Patrick W.
2. Latex Line by Line, Diller, Wiley.

REFERENCE BOOKS:

1. LATEX: A Document Preparation System, User's Guide and Reference Manual., L. LamportAddison-Wesley, New York, second edition, 1994

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	1	2	1	1	3	3	1	2	1	1	1	2	2
CO2	3	1	3	1	1	3	3	1	3	1	1	3	3	2	3
CO3	2	3	3	1	2	1	2	3	3	1	2	1	2	2	3
CO4	1	1	3	3	1	1	1	1	3	3	1	1	2	3	3
CO5	3	3	3	1	2	1	3	3	3	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course code	**: MT133**
Course title	**: Communication Skills-II**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 1.5 L:0 T: 0	**P: 3**
Class schedule per week	**: 03**
Semester / Level	**: II/1**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Analyze and demonstrate writing and speaking processes through invention, organization, drafting, revision, editing, and presentation.
B.	Understand the importance of specifying audience and purpose and to select appropriate communication choices.
C.	Interpret and appropriately apply modes of expression, i.e., descriptive, expositive, narrative, scientific, and self-expressive, in written, visual, and oral communication.
D.	Participate effectively in groups with emphasis on listening, critical and reflective thinking, and responding.
E.	Develop the ability to research and write a documented paper and/or to give an oral presentation.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Apply business communication strategies and principles to prepare effective communication for domestic and international business situations.
CO2	Utilize analytical and problem-solving skills appropriate to business communication.
CO3	Participate in team activities that lead to the development of collaborative work skills.
CO4	Select appropriate organizational formats and channels used in developing and presenting business messages
CO5	Communicate via electronic mail, Internet, and other technologies and deliver an effective oral business presentation.

Module I: Building a Business Vocabulary

Vocabulary related to company culture, Phrasal verbs *Board, bottom line, revenues*, etc.; Words related to leadership skills: *founder*, etc.; Types of management; Abbreviations; Meeting related vocabulary; Vocabulary related to submitting tenders; Pricing *Dedicated*, *resources*, etc.; Verb–noun collocations; Linking words and phrases *Existing*, *identify*, etc.; *Brand-building*, etc.; Types of advertising *Households*, etc.; Synonyms for *increase* and *decrease; Solicit, risk-averse*, etc.; Phrasal verbs and expressions like *go bust, stock price*, etc.; Vocabulary from profit-and-loss account; and balance sheet; Theatre vocabulary *Break down, running costs*, etc; *Bank charges*, *bookkeeping,* etc.; Formal expressions; Types of workers; Ways of working; Phrases for negotiating; *Benefits, premise*, etc.; Adverbial phrases; *Acquisitions*, *year on year,* etc.; Adjectives and adverbs of frequency; Discourse markers for short talks

Module II: Listening at the Workplace

Listening to descriptions of company culture; Listening to a talk on leaders and managers;

Advice for communicating effectively with colleagues; Listening to a talk on Customer Relationship Management; Listening to a presentation; Listening to a talk on effectiveness of advertising; Listening to a talk on sales activities; Listening to a sales pitch; Listening to a sales forecast; Listening to a business conversation; Listening to people talk about their jobs; Listening to interviews with production managers; Listening to staff complaints and demands; Listening to a talk on risk in business

Module III: Oral communication at the workplace
Describing company culture; Talking about good leaders; Communicating in meetings;
Discussing customer–supplier relationships; Presenting information from charts; Presenting from a text; Cost-effective advertising; How to advertise software; Using the Internet for advertising; Finding out about work problems; Making a sales pitch; Negotiation, problems and advice; Talk: teleworking, etc.; Talking about your present job; Describing charts; Presentations on productivity; Negotiating an agreement; Describing the company you work for; Useful hints for making presentations; Making a presentation; Discussion on staff retention, market share, etc.

Module IV: Reading for Business
Reading internal messages (memo, email, note, notice); Reading a summary of action points; Reading a business forecast; Reading articles on Customer Relationship Management; Reading about how a company prepares tenders; Reading a proposal; Reading extracts on measuring the impact of advertising; Reading a brief sales report; Reading a report on productivity; Reading a memo from a CEO; Reading a business letter

Module V: Business Correspondence:
Replying to messages; Writing and replying to a memo, email or notice; A proposal for investigating new markets; A report on advertisers and target audiences; A sales report based on a chart; Report on a sales event for a product launch; A proposal for sponsoring an arts or sports event; Letter complaining about late payment; Email summarising results of negotiation; Short report on stress and absenteeism; Report on changes to company organization; Memo summarising agreement; Proposal to give your company a more ethical image; Letter to prospective customers; Letter expressing interest in business approach

TEXT BOOKS:

1. Communication Skills IInd edition, Sanjay Kumar & PushpLata, Oxford University Press
2. Business Correspondence and Report Writing, R.C.Sharma, Krishna Mohan. Mcgraw Hill.
3. Communication for Business, Shirley Taylor, V.Chandra, Pearson
4. Basic Business Communication- .Lesikar I Flatley, McGraw Hill.
5. Business Communication Today, Bovee, Thill and Chatterjee, Pearson Suggested coursebook:

Business Benchmark Advanced (Student's Book with CD-ROM) ISBN: 9780521743686, Cambridge University Press
CEFR level: C1
Recommended reading: *Business Vocabulary in Use* Advanced (PB with CD-ROM) ISBN: 9781107604582 *Soft Skills & Employability Skills* ISBN: 9781316981320

Course Code : **CN122**
Course Title : **DATA STRUCTURES LAB**
Pre-requisite(s) :
Co- requisite(s) : **Introduction to Data Structures**
Credits:2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **II/1**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Assess how the choice of data structures and algorithm design methods impact the performance of programs.
B.	Choose the appropriate data structure and algorithm design method for a specific application.
C.	Solve problems using data structures such as linear lists, stacks, queues, binary trees, heaps, binary search trees, and graphs and writing programs for these solutions.
D.	Familiarity with major algorithms and data structures and analyze performance of algorithms.
E.	Implementation of different sorting and searching technique and analyze their performance.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Choose an appropriate data structure given a computational problem.
CO2	Design and analyze the time and space efficiency of various data structures.
CO3	Analyze run-time execution of various searching and sorting methods, including insertion sort, selection sort, merge sort, heap sort and Quick sort.
CO4	Have practical knowledge on the applications of data structures.
CO5	Justify the choice of data structure for a given problem.

Syllabus

List of Programs as Assignments:

1. Program to implement linear search and binary search using arrays.
2. Write a program to perform following tasks in a one-dimensional array
    a. Creation of N Integer (as specified by the user) elements.
    b. Displaying array elements
    c. Inserting an element (ELEM) at a given valid position (POS).
    d. Deleting an element at a given valid position (POS).
    e. changing element at a valid position
3. Write a program to create a single link list and perform following tasks
    a. Inserting an element at the end.
    b. Inserting an element at the beginning
    c. Inserting elements in sorted fashion
    d. Reverse the link list
    e. concatenate two link list

    f. split the link list into nearly two equal halves
    g. Display the elements of the list
    h. Display the list in reverse fashion
    i. inserting an element before/after a given element
    j. deleting a particular element
    k. Counting no of elements
4. Write a program to create a Double Link List and perform the tasks outlined above.
5. Write a program to create a Circular link list and perform the tasks outlined in 3.
6. Write a program to implement stack ADT using arrays and link list.
7. Write a menu driven program to create a polynomial in two variables and add, differentiate, and integrate the polynomials and display them.
8. Write a program to reverse a string using stack.
9. Write a program to convert decimal number to binary, hexadecimal, octal, as per user's choice using stack ADT.
10. Write a program (using stack) to
    a. convert an Infix Expression into Postfix and Postfix Evaluation
    b. convert an infix Expression into Prefix and Prefix Evaluation
11. Write a program for matching parenthesis using stack.
12. Write a Program to implement multiple stacks in a single array
13. Write a Program to implement queue using arrays and linked list.
14. Write a program to reverse elements in a queue
15. Write a Program to implement circular queue using arrays and circular link list.
16. Implement Stack using queue.
17. Implement Linear Queue, Circular Queue ADT using stack and linked list.
18. Write a Program for the creation of binary search tree and perform following tasks: insertion & deletion, pre-order, post-order & in-order traversals, computing height of tree, counting number of leaf node, counting number of non-leaf nodes, counting total number of nodes of a binary tree, finding minimum and maximum element.
19. Write a non-recursive code to perform in-order traversal of a binary tree.
20. Write a program to perform BFS (level order) traversal in a Binary tree.
21. Write a Program for implementation of B-tree (insertion & deletion)
22. Write a Program for implementation of multi-way tree in c
23. Write a Program for implementation of AVL tree
24. Write a Program to implement following sort procedure using arrays
    a. Merge sort
    b. Selection sort
    c. Insertion sort
    d. Quick sort
    e. Heap sort
25. Write a program to implement Adjacency Matrix and adjacency list representation of graph.
26. Write a Program to implement DFS and BFS traversal.

TEXT BOOKS:

1. Baluja G S, "Data Structure through C", Ganpat Rai Publication, New Delhi.
2. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", Tata McGraw-Hill.
3. Horowitz E., Sahni S., Susan A., "Fundamentals of Data Structures in C", University Press.

REFERENCE BOOKS:

1. Tremblay J. P., Sorenson P. G, "An Introduction to Data Structures with Applications", McGraw-Hill.

2. Lipschutz Seymour, “Data Structures”, Tata McGraw-Hill.
3. Drozdek Adam, “Data Structures and Algorithms in C++”, Thomson Learning, New Delhi.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	2	3	2	3	2	3	3	3	2	3
CO2	2	2	2	3	2	1	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	1	1	1	2	1	1	1	2	2	2	3
CO4	3	3	3	3	2	1	2	2	3	3	3	3	3	3	3
CO5	3	3	3	3	2	2	2	2	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

SEMESTER III

Course Code	**: CN201**
Course Title	**: JAVA PROGRAMMING**
Pre-requisite(s)	**: Programming and Problem-solving using C/C++**
Co- requisite(s)	**: JAVA Lab**
Credits: 3 L: 3 T: 0	**P: 0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: III/2**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Learn about Object oriented programming concepts.
B.	Learn how to use the JDK for java programming.
C.	Improve their programming skills in core Java using various methods, overloading and overriding of methods.
D.	Use java interfaces, packages and exception handling to do java-based projects.
E.	Use the knowledge of java to do applet programming and GUI designing.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Get clear idea about the JDK and its evolution and use it for program execution.
CO2	Understand the concepts of OOP and identify the latest know-how related to the new developments in the field of Java.
CO3	Apply core java to design programming-based solutions.
CO4	Get clear knowledge on Dynamic memory management, generalization and specialization in Java.
CO5	Able to do applet programming and create basic GUI in Java.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Procedure-Oriented Programming, Object-Oriented programming, Benefits of OOP, Applications of OOP, Basics, Evolution of Java, Structure of JAVA Program, Simple Java Program, Tokens, Comments, Identifiers, Operators, Literals, Control Structures. Java Environment Setup, Compiling a Java Program, Java Virtual Machine, Philosophy of Java and Benefits.	**6**
Module 2 Data types: Primitive and reference data types, variables and constants, enumerated constants. Control Structure in Java. Program statements: labelled statement, expression and null statements, compound statement, control statement – decision and loops, jump statement, try-throw-catch-finally statement, declaring and creating arrays, accessing array elements, assigning values to array elements, multidimensional arrays.	**8**

Module 3 Functions: Declaration, definition and call, main method arguments, reference variables, method overloading, parameter passing by value for primitive types, object references and arrays, scope of variables, return from methods. Class and object, class members and initialization, access rights of members – public, private and protected access modifiers, constructor and copy constructor, mutability, finalization, dynamic memory management, garbage collection, this keyword, static members, scope of variables, interface – declaration, implementation and extending, package and package visibility.	**9**
Module 4 Inheritance and Collection classes: multi-level and single inheritance, multiple inheritance of interfaces, Object class, access rights in subclasses and packages, constructor calling sequence, super keyword, dynamic binding of methods, abstract class, overriding, finalize, association, aggregation and composition.	**8**
Module 5 Basics of Applet programming, applet code example, HTML tags for applet, applet life cycle, color, font and basic GUI handling, basic graphics, and animation. Input/Output and JAVA Applets: Stream classes – InputStream, OutputStream, Buffered Stream, file classes and handling, pushback streams, reader and writer classes, file reader and writer, serialization.	**9**

TEXT BOOKS:

1. Balagurusamy E., "Programming in Java", 2nd Edition, Tata McGraw Hill Publication, New Delhi.
2. Jana D., Java and Object-Oriented Programming Paradigm, PHI, 2010.

REFERENCE BOOKS:

1. Naghton Patrick &Schildt H., "The Complete Reference Java 2", Tata McGraw Hill Publication, New Delhi.
2. Dietel Harvey M &Dietel Paul J., "Java How to program", 7th edition, Pearson Education, New Delhi.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Multithreading process in Java.
2. Detailed applet programming.

POs met through Gaps in the Syllabus: 3, 11, 12

Topics beyond syllabus/Advanced topics/Design:

1. Concepts of multithreading in Java
2. Detailed knowledge on GUI designs in Java
3. Database connectivity with front end

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	1	3	1	3	2	1	2	3	2	3	1	1	2	2
CO2	3	2	3	2	3	2	2	2	3	2	3	2	2	3	2
CO3	3	3	3	3	2	3	3	2	2	2	3	3	3	2	3
CO4	3	3	3	3	3	3	2	2	2	2	2	3	2	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN203**
Course Title : **DATABASE MANAGEMENT SYSTEMS**
Pre-requisite(s) :
Co- requisite(s) : **DBMS Lab**
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the structure of databases.
B.	Learn Query processing and decomposition.
C.	Understand how to create a database.
D.	Learn transaction processing in databases.
E.	Understand how concurrency control is performed in a database.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Design a database for a given set of requirements.
CO2	Use SQL.
CO3	Apply normalization techniques on given database.
CO4	Have knowledge of indexing and hashing mechanisms in a database management system.
CO5	Have idea of the backend activities involved in extracting data from a database. Have knowledge of transaction and concurrency control mechanisms in a database management system.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction:** Purpose of Database Systems, View of Data, Data Models, Database Languages, Relational Database, Database Architecture, Database Users and Administrators, Transaction Management.	**8**
Module 2 **Relational Data Models and Languages:** Basic Concepts, Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R Features, Reduction of an E-R Diagram to Tables, The Relational Algebra, The Tuple Relational Calculus and The Domain Relational Calculus.	**10**

Module 3 **Relational-Database Design:** Pitfalls in Relational-Database Design, Functional Dependencies, Decomposition, Desirable Properties of Decomposition, First Normal Form, Second Normal Form, Third normal Form, Boyce-Codd Normal Form, Fourth Normal Form and More Normal Forms.	**7**
Module 4 **Query Processing and Optimization:** Overview, Measures of Query Cost, Selection Operation, Join Operation, Other Operations, Evaluation of Expressions, Transformationof Relational Expressions, Estimating Statistics of Expression Results, and Choice of Evaluation Plans.	**8**
Module 5 **Transactions and Concurrency Control:** Transaction Concept, Transaction State, Desirable Properties of Transactions, Concurrent Executions, Serializability, Recoverability, Lock-Based Protocols, Timestamp-Based Protocols and Deadlock Handling.	**7**

TEXT BOOKS:

1. Silberschatz, Korth, &Sudarshan, "Database System Concepts", 6^{th} Edition, McGraw Hill.

REFERENCE BOOKS:

1. Elmasri, & Navathe, "Fundamentals of Database Systems, 5^{th} Edition, Pearson Education, 2008.
2. DateC.J.,"AnIntroductiontoDatabaseSystem",PearsonEducation,New Delhi,2005.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO2	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO3	2	2	2	1	1	2	1	1	1	1	1	1	2	2	3
CO4	1	2	1	3	1	1	1	2	2	1	2	2	2	2	3
CO5	3	3	3	1	2	1	1	1	2	2	2	2	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD5, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD8, CD9, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD8, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN205**
Course Title : **CONCEPT OF PROGRAMMING LANGUAGES**
Pre-requisite(s) : **Fundamentals of Computer Science**
Co- requisite(s) :
Credits:2 L:2 T:0 P:0
Class schedule per week : **02**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Describe and classify various programming languages and data types.
B.	Summarize the sequence control.
C.	Generalize various object-oriented programming paradigms.
D.	Discuss about Logical and functional programming
E.	Summarize the concept of concurrent programming.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand various programming concepts and data types.
CO2	Apply various sequence control techniques of programming languages.
CO3	Understand the object-oriented programming.
CO4	Analyze logical and functional programming.
CO5	Understand about concurrent programming.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **INTRODUCTION** Role of programming languages – Need to study programming languages – Characteristics of a good programming languages – Introduction to various programming paradigms: Procedural – Object-oriented – Logic and functional – Concurrent programming. Data Types: Properties of structured and non-structured data types and Objects – Variables – Constants – Derived and abstract data types – Declaration – Type checking. Binding and binding times – Type conversion – Scalar data type – Composite data types – Implementation and Storage representation of data types and control flow statement.	**6**
Module 2 **SEQUENCE CONTROL** Sequence Control: Implicit and explicit sequence control – Sequencing with arithmetic and non-arithmetic expressions – Sequence control between statements.	**6**

Subprograms control: Subprogram sequence control – Attributes of data control – Shared data in.	
Module 3 **OBJECT ORIENTED PROGRAMMING** Object Oriented Programming: The class declarations – Constructors – Information hiding and data abstraction using classes – Access specification – Inheritance – Polymorphism – Parameterized types – Exception handling.	**6**
Module 4 **LOGICAL AND FUNCTIONAL PROGRAMMING** Logic Programming: Logic programming language model – Logical statements – Resolution – unification – search structures: backward and forward – Applications of logic programming – PROLOG. Functional Programming: Features of functional languages – LISP – Applications of functional and logic programming languages.	**6**
Module 5 **CONCURRENT PROGRAMMING** Basic concepts of Concurrent Programming: processes – Synchronization primitives – Safety and liveness properties – Parallelism in Hardware – Streams – Concurrency as interleaving – Safe access to shared data.	**6**

TEXT BOOKS:

1. Ghezzi C, Milano P., Jazayeri M., "Programming Languages Concepts", Pearson.
2. Scbesta R., "Concepts of Programming Languages", Pearson Education.

REFERENCE BOOKS:

1. Sethi R., "Programming Languages concepts & constructs", Pearson Education.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	3	2	3	2	2	3	3
CO2	3	1	1	1	1	3	1	1	3	3	3	2	2	3	2
CO3	2	3	3	1	2	1	2	2	2	1	1	2	3	2	3
CO4	1	1	3	3	1	1	1	1	2	1	1	2	3	2	2
CO5	3	3	3	1	2	1	1	2	1	1	1	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1. CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN207**
Course Title : **MATHEMATICS FOR COMPUTING II**
Pre-requisite(s) :
Co- requisite(s) :
Credits:3 L: 3 T:0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Gain knowledge on formal methods of logic.
B.	Show a competent understanding of the basic proofing concepts.
C.	Understand the concepts of number theory.
D.	Solving Problems using Linear Algebra.
E.	Learn the concepts of Probability and Distribution.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Demonstrate the formal methods of logic.
CO2	Prove theorems using appropriate methods.
CO3	Apply number theory concepts.
CO4	Analyze to solve Problem using linear algebra.
CO5	Solve the problems using probabilistic methods.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Propositional Logic: Introduction, Construction of truth table, Connectives, Compound Statements, Tautology, Contradiction, Contingency, Inference Rules, Conjunctive and disjunctive normal forms, semantics, Truth Tables, tautology, Adequate Set of Connectives.	**8**
Module 2 Introduction to proofs, Methods of proof, direct proof, consistency, contraposition, contradiction (reduction, absurdum), mathematically induction, proof by cases.	**8**
Module 3 Number Theory: Division algorithm, Greatest common divisor, least common multiple, Linear Diophantine equations, Fundamental Theorem of Arithmetic, definition of congruence, Residue System, Test of Divisibility, linear congruence.	**8**

Module 4 Linear Algebra: System of linear equations, Gauss Elimination method, Matrices, Gauss-Jordan method for finding matrix inverse, Elementary matrices, Matrix rank, Eigenvectors.	**8**
Module 5 Discrete Probability, Sample Space, Events, Probability of an Events, Addition and Multiplication Rule of Probability, Probability Distribution, Expectation, Standard Deviation, Binomial, Poisson and Normal Distribution.	**8**

TEXT BOOKS:

1. Kolman, B.; Busby, R. and Ross, S.: Discrete Mathematical Structures (6e), Pearson Education India –ISBN 978-9332549593.
2. Elliott Mendelson; Introduction to Mathematical Logic; Chapman & Hall; London (1997)
3. Murray R. Spiegel, John J. Schiller, R. Alu Srinivasan; Probability and Statistics, Schaum's Outline Series.
4. Grewal, B.S. "Higher Engineering Mathematics", Khanna Publication
5. S B Malik, Basic Number Theory, Vikash Publishing House Pvt. Ltd., 2nd Revised Edition

REFERENCE BOOKS:

1. Discrete Structure & Graph Theory, Rathore, EPH
2. J.H.Gallier; Logic for Computer Science; John.Wiley & Sons (1987).

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	1	1	1	2	1	1	1	1	2	2	2	1	1	1
CO2	2	2	2	1	2	1	1	1	1	1	2	2	1	1	1
CO3	2	3	3	1	3	1	1	1	1	1	2	3	3	1	1
CO4	2	2	2	3	3	1	1	1	2	1	3	3	3	2	1
CO5	2	2	3	2	3	1	1	1	3	2	3	3	3	2	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN209**
Course Title : **STATISTICS WITH R**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L:2 T:0 P:2
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the importance of data and how to collect, organize and summarise those data.
B.	Describe preliminary statistical techniques to solve problems.
C.	Understand how to create a database.
D.	Explain the merits and limitations of different statistical techniques.
E.	Understand the statistical concepts, interpreting results, and using R for data manipulation and analysis.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Evaluate the need for data analysis.
CO2	Formulate the statistical problem and solve it with R language.
CO3	Design and describe problems of inferential statistics with R language.
CO4	Understand the statistical concepts for data manipulation and analysis.
CO5	Understand Basics of statistical modelling and model selection using R.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module I Introduction to Statistics: Definition of Statistics, Scope of Statistics, Types of Data. Methods of collecting Data, Diagrammatic and Graphic Presentation of Data, Graphs of Frequency Distribution.	**8**
Module II Measures of Central Tendency: Need for measuring central tendency of data; Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. merits and demerits. Numerical exercises.	**6**
Module III Measures of Dispersion: Need for measuring dispersion of data; Range, Mean Absolute Deviation, Quartile Deviation, Standard deviation, Coefficient of Variation: their properties, vector, merits and demerits. Numerical exercises.	**6**

Module IV Probability and Probability Distribution Basic probability concepts, Normal Distribution, Binomial Distribution, Poisson Distribution. Other Distributions using R for probability calculations and distribution plots.	**6**
Module V Correlation and Covariance. T-Tests, ANOVA. Linear Models. Simple Linear Regression, Multiple Regression, Generalized Linear Models, Logistic Regression, Poisson Regression, Other Generalized Linear Models.	**6**

Lab Exercise:

1. Write a R program to take input from the user and display the values.
2. Write a R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
3. Write a R program to create a vector which contains 10 random integer values between -20 and +20.
4. Write a R program to find the maximum and the minimum value of a given vector.
5. Write a R program to create a list of random numbers in normal distribution and count occurrences of each value.
6. Write a R program to read the .csv file and display the content.
7. Write a R program to create three vectors numeric data, character data and logical data. Display the content of the vectors and their type.
8. Write a R program to create a 5 x 4 matrix , 3 x 3 matrix with labels and fill the matrix by rows and 2 × 2 matrix with labels and fill the matrix by columns.
9. Write a R program to create an array, passing in a vector of values and a vector of dimensions. Also provide names for each dimension.
10. Write a R program to draw an empty plot and an empty plot specify the axes limits of the graphic.
11. Write a R program to create a simple bar plot of five subjects marks.
12. Create a scatter plot of the data points and overlay the regression line using the function plot() and abline().
13. Customize the plot by adding axis labels, a title, and appropriate visual enhancements.
14. Perform Multiple Linear Regression:Extend the analysis by including multiple independent variables ("x1", "x2", etc.) in the regression model. Use the function lm() with the appropriate formula.
15. Conduct model diagnostics to evaluate the assumptions of linear regression. This can include examining residual plots, checking for multicollinearity, and testing for heteroscedasticity.

TEXT BOOKS:

1. Jared P. Lander, R for Everyone: Advanced Analytics and Graphics, The Addison-Wesley Data and Analytics Series.
2. Gupta S.P. and Gupta M.P. (2015), Business Statistics. (Sultan Chand & Sons: New Delhi).18th ed.
3. Das N.G. (2017). Statistical Methods (combined volumes). (Tata McGraw-Hill: New Delhi).

REFERENCE BOOKS:

1. Richard I. Levin, David S. Rubin, Masood H. Siddiqui (2017), Statistics for Management. (Pearson: New Delhi) 8th ed.
2. Hogg Robert V., Mckean Joeseph, Craig Allen T. (2017), Introduction to Mathematical Statistics (Pearson: New Delhi) 7th ed.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO2	3	3	3	2	1	2	2	1	1	2	1	1	2	2	3
CO3	2	2	2	1	1	2	1	1	1	1	1	1	2	2	3
CO4	1	2	1	3	1	1	1	2	2	1	2	2	2	2	3
CO5	3	3	3	1	2	1	1	1	2	2	2	2	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD5, CD2
CD4	Mini Projects/Projects	CO4	CD1, CD8, CD9, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD8, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN202**
Course Title : **JAVA LAB**
Pre-requisite(s) : **Programming and problem-solving using C/C++ Lab**
Co- requisite(s) : **Java Programming**
Credits: 2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn about Object oriented programming concepts.
B.	Learn how to use the JDK for java programming.
C.	Improve their programming skills in core Java using various methods, overloading and overriding of methods.
D.	Use java interfaces, packages and exception handling to do java-based projects.
E.	Use the knowledge of java to do applet programming and GUI designing.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Elaborate the use of JDK of various versions for programming.
CO2	Identify the latest know-how related to the new developments in the field of Java.
CO3	Apply the knowledge gained for their project work as well as to develop some GUI applications.
CO4	Design solutions in JAVA.
CO5	Apply features of Java Applets through programming.

Syllabus

List of Programs as Assignments:

1. WAJP to show the characteristic of a number. {E.g. 24 it has two coefficients 2 in tens position and 4 in units position. It is composed of 2 and 3. It is a positive number. Also show whether it is odd or even. Tell the number of digits.}
2. WAJP to take input through command line argument and do the following:
   a) Check whether the number is prime or not.
   b) Count the number of digits.
3. Write a menu driven program using switch in Java to perform following:
   a) For input of 1, check whether the number is prime or not
   b) For input of 3, find the factors of the number
   c) For input of 5, check the number is odd or even.
   d) For input of 7 generate the reverse of the number
4. Write a program in Java to generate
   a) Hexadecimal equivalent of a number without using array.
   b) Hexadecimal equivalent of a number using array.
5. WAJP to take two number inputs through command line argument and do the following:
   a) Check whether two numbers are prime to each other or not OR evaluate the HCF

of two numbers.

b) Find LCM of two numbers.

6. WAJP to compute and display the count of occurrence of 4 in a number. E.g. 4564 will compute 2.
7. WAJP to sort a list of numbers in ascending order.
8. WAJP to generate Pascal's Triangle using a square matrix.
9. Write a program in Java to take input of two 3×3 matrices through command line argument and then:
   a) Add them up and display the result
   b) Subtract them and display the result
   c) Generate the transpose of the matrix
   d) Multiply them and display product
10. WAJP to count the number of words, characters in a sentence.
11. Write a program in Java to display the Floyd's triangle.
12. Write a program in Java to search an element using the principle of binary search (without using any built-in method)
13. Write a program in Java to print the smallest number in an array.
14. Write a program in Java to check for duplicate entries in an array.
15. Write a program in Java to take input of a sentence and then count the number of words and vowels.
16. WAJP to handle the Exception using try and multiple catch block; the exceptions that you will handle are, number format error, array bound error and divide by zero.
17. WAJP to create a class called **Room** with two data member length and width and then implement constructor overloading in it.
18. Write a program in Java to explain the role of the following:
   a) Non-parameterized constructor
   b) Parameterized constructor
   c) Copy constructor

   Take input and display the output.
19. WAJP to create a class called **Fraction** with data member numerator and denominator; take input (through command line argument) of two fractions and then add, subtract, multiply and divide, finally display the result in reduced term.
20. Write a program in Java to create a class for **Employee** having 2 data member code and name. Then create 3 classes **Officer**, **AdminStaff** and **MStaff**. The **Officer** class has data members designation and pay-scale; the **AdminStaff** has data members grade and pay-band; the **MStaff** has data member department and two sub-classes **Regular** and **Casual**. The **Regular** staff has data members level and consolidated-pay and **Casual** has data member daily-wage. Take all inputs through constructors and write appropriate methods for displaying one data for each type of class.
21. WAJP to design a class called **Account** using the inheritance and static that show all function of bank (withdrawal, deposit) and generate account number dynamically.
22. WAJP to design an application *Password.java* that produces and prints a random password depending upon name of an individual. If the input is Abdul Kalam then the password would be *33421LAM*. Note: take the first name A=1, B=2, D=4, U=21 where 2+1=3, and L=12, where 1+2=3; so the number equivalent to ABDUL comes to be *12433*, and last 3 alphabets of the last name, so u can find out.
23. WAJP to draw a format like

```
   *
  ***
 *****
*******
```

*****
***
*

24. WAJP to take a string count all vowels and then delete the same from the string.
25. Write a **Patient** class which inherits from the **Person** class. Patient can again be of two types, indoor and outdoor. The Patient class requires the following:
    a) a variable to store the patient ID for the patient
    b) a variable to store the department of hospital
    c) a variable to store the ward of hospital
    d) a variable to store the patient 's date of joining the hospital
    e) a variable to store the patient 's address
    f) a variable to store the medical fees that the patient pays
    g) constructor methods, which initialize the variables
    h) a method to calculate the medical fees (for both indoor and outdoor patient)
26. WAJP to take a string as password and check whether it contains at least two numbers, 3 alphabets and no space in it. If any contrary throw message.
27. Write a program in Java to print a format like,

* * * * * * *
* * * * *
* * *
*

28. Write a class called **Shape** which contains a user-defined interface for **Computation**, which contains methods for calculation of area, perimeter and volume. Write four classes for **circle, rectangle, sphere** and **rectangular parallelepiped**, and all these classes inherit from Shape. Now take input for the following:
    a) radius of circle and compute its area and perimeter
    b) Length and breadth of rectangle and compute its area and perimeter
    c) Length, breadth and height for **rectangular parallelepiped** and compute its area and volume, where A=2(wl+hl+hw) and V=lwh
    d) Radius of sphere and compute its area and volume
29. Write a class called Employee, which requires the following:
    a) a variable to store the employee ID
       employee ID should be of format EMP**M**1234, EMP**S**1234, EMP**A**1234, EMP**C**1234, where M=manager, S=supervisor, A=analyst, C=clerk; number can be any no. but first three characters should be EMP
    b) a variable to store the employee name
    c) a variable to store department
    d) a variable to store city
    e) a variable to store basic salary
    f) a method to calculate the salary of employee
       i. if the city is metro then the HRA would be 30% else 20%
       ii. if the employee ID contain M then DA would be 120%, if S then DA would be 110%, if A then DA would be 100%, and if C then DA would be 90%
    g) constructor methods, which initialize the variables
30. Write a program in Java to find the second largest element in an array.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Multithreading process in Java.
2. Detailed applet programming.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Concepts of multithreading in Java
2. Detailed knowledge on GUI designs in Java
3. Database connectivity with front end

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD5, CD1, CD2
CD2	Tutorials/Assignments	CO2	CD5, CD1, CD2
CD3	Seminars	CO3	CD5, CD1, CD2, CD4
CD4	Mini Projects/Projects	CO4	CD5, CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD5, CD1, CD2, CD4
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN204**
Course Title : **DBMS LAB**
Pre-requisite(s) :
Co- requisite(s) : **Database Management Systems**
Credits: 2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **III/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the structure of databases.
B.	Learn Query processing and decomposition.
C.	Understand how to create a database.
D.	Learn transaction processing in databases.
E.	Understand how concurrency control is performed in a database.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Design a database for a given set of requirements.
CO2	Use SQL.
CO3	Apply normalization techniques on given database.
CO4	Have knowledge of indexing and hashing' mechanisms in a database management system.
CO5	Have idea of the backend activities involved in extracting data from a database. Have knowledge of transaction and concurrency control mechanisms in a database management system.

Syllabus

List of Programs as Assignments

Consider the following tables: emp(empno, ename, job, mgr, hiredate, sal, comm, deptno, gr), dept(deptno, dname, loc)

Write the following queries:

1. List all information about all department from emp table.
2. List all employee names along with their salaries from emp table.
3. List all department numbers, employee numbers and their managers numbers in descending order of deptno from emp table.
4. List department names and locations from the dept table.
5. List the employees belonging to the department 20.
6. List the name and salary of the employees whose salary is more than 1000.
7. List the names of the clerks working in the department 20.
8. List the names of analysts and salesmen.
9. List the details of the employees who have joined before the end of September 81.
10. List the names of employees who are not managers.
11. List the names of employees whose employee number are 7369, 7521, 7839, 7934, 7788.

12. List the employee details not belonging to the department 10, 30, and 40.
13. List the employee name and salary, whose salary is between 1000 and 2000.
14. List the employee names, who are not eligible for commission.(salary having >15,000 eligible for commission)
15. List the employees who are eligible for commission.
16. List the details of employees, whose salary is greater than 2000 and commission is NULL.
17. List the employees whose names start with an “S” (not's”).
18. List the name, salary and PF amount of all the employees(PF is calculated as 10% of salary).
19. List the empno, ename, sal in ascending order of salary.
20. List the employee name, salary, job and Department no descending order of Department No and salary.
21. List the employee details in ascending order of salary.
22. List the employee details in descending order of salary
23. Display name, and sal and commission of all employees whose monthly salary is greater than their commission.

Create following tables from KORTH BOOK

Account_table
Branch_table
Depositor_table
Customer_table
Borrower_table

Solve the following queries using SQL.

1. Find all account numbers for account at the Redwood branch with assets greater than 300000.
2. Find the customer names, account numbers, balance for all accounts at the Perryridge branch.
3. Find the names of all branches that have assets greater than at least one branch located in Brooklyn.
4. Find the names of all customers whose street address includes the substring ‘North’.
5. To find all customers having a loan, account, or both at the bank .
6. Find the average account balance at the Brighton branch.
7. Find the number of depositors for each branch.
8. Find the number of depositors for each branch where average account balance is more than 1200.
9. Find the average balance for each customer who lives in Palo Alto and has at least two accounts.
10. Find the names of customers who do not have a loan at the bank, and whose names are neither Smith nor Jones.
11. Find the maximum across all branches of the total balance at each branch.

TEXT BOOKS:

1. SQL, PL/SQL the programming Language of Oracle, Ivan Bayross, 4^{th} edition

REFERENCE BOOKS:

1. Beginning Oracle SQL: For Oracle Database 12c , Tim Gorman, Inger Jorgensen, Melanie Caffrey · 2014

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	1	1	1	1	1	1	1	1	1	1	2	3	1	1
CO2	3	2	2	2	1	1	1	1	1	1	1	2	3	1	1
CO3	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD5, CD8, CD9
CD2	Tutorials/Assignments	CO2	CD5, CD9
CD3	Seminars	CO3	CD5, CD9
CD4	Mini Projects/Projects	CO4	CD5, CD6, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD5, CD6, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

SEMESTER IV

Course Code : **CN221**
Course Title : **SOFTWARE ENGINEERING**
Pre-requisite(s) :
Co- requisite(s) : **Software Engineering Lab**
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the importance, limitations and challenges of processes involved in software development.
B.	Gain knowledge of various software models.
C.	Learn about software requirements analysis and specification.
D.	Gain knowledge of various software design activities.
E.	Learn cost estimation, software testing, maintenance and debugging.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify the difference of software engineering discipline with the otherengineering disciplines.
CO2	Elaborate knowledge of various software models.
CO3	Analyze about software requirements analysis and specification.
CO4	Infer from knowledge of various software design activities.
CO5	Implement cost estimation, software testing, maintenance and debugging.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction:** The Software Engineering Discipline – Evolution and Impact, Programs vs. Software Products, Why Study Software Engineering? Emergence of Software Engineering, Notable Changes in Software Development Practices and Computer Systems Engineering. **Software Life Cycles Models:** Classical Waterfall Model, Iterative Waterfall Model,Prototyping Model, Evolutionary Model, Spiral Model and Comparison of Different Life Cycle Models.	**8**
Module 2 **Software Project Management:** Responsibilities of a Software Project Manager, Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, Empirical Estimation Techniques, COCOMO – A Heuristic Estimation Technique, Scheduling and Risk Management.	**8**

Requirement Analysis and Specifications: Requirements Gathering and Analysis and Software Requirements Specification.	
Module 3 **Software Design:** What is a Good Software Design? Cohesion and Coupling, Neat Arrangement. **Software Design Approaches**, Object-Oriented vs. Function-Oriented Design, Overview of SA/SD Methodology, Structured Analysis, Data Flow Diagrams, Structured Design, **Object Modelling Using UML**: Overview, UML, UML Diagrams, Use Case Model, Class Diagrams Design Patterns, Object-Oriented analysis and Design Process.	**8**
Module 4 **Coding and Testing:** Coding, Code Review, Testing, Unit Testing, Black-Box Testing, White-Box Testing, Debugging, Integration Testing and System Testing. **Software Reliability and Quality Management**: S/W Reliability, Statistical Testing,S/W Quality, S/W Quality Management System, ISO 9000, SEI CMM, Personal Software Process, Six Sigma.	**8**
Module 5 **Software Maintenance**: Characteristics, S/W Reverse Engineering, S/W Maintenance Process Models, Estimation of Maintenance Cost.	**8**

TEXT BOOKS:

1. Rajib Mall, Fundamentals of Software Engineering, 4th Edition, PHI, 2014.

REFERENCE BOOKS:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa, 2005.
2. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education, 2011.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Model-driven software development
2. Aspect-oriented software development

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	2	2	1	2	2	2	2	1	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course code : **CN223**
Course title : **PYTHON PROGRAMMING**
Pre-requisite(s) :
Co- requisite(s) : **Python Programming Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand computer programming concept using python language.
B.	Explore basic data types, control structures and standard library functions.
C.	Explore the basic data structures: List, Tuple, Sets, Dictionaries available in python.
D	Learning Object oriented concept of programming and its implementation in python.
E.	Handle disk data file for input output operations.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Solve the basic mathematical problem using python programming.
CO2	Use basic data types control structures and utility functions from standard library for faster programming.
CO3	Use the basic and user defined data structures as per the need of problem.
CO4	Design and implement the problem using OOP concept of python.
CO5	Store, retrieve and manipulate data with disk file.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module – I **Introduction to Computers, Programs, and Python:** Introduction, Programming Languages, Operating Systems, The History of Python, Features of python language, Getting Started with Python, Programming Style and Documentation, Programming Errors. **Elementary Programming:** Introduction, Writing a Simple Program, Reading Input from the Console, Identifiers, Variables, Assignment Statements, and Expressions, Simultaneous Assignments, Named Constants, Numeric Data Types and Operators, Evaluating Expressions and Operator Precedence, Augmented Assignment Operators, Type Conversions and Rounding.	**8**
Module – II **Mathematical Functions, Strings and Objects**: Introduction, Common Python Functions, Strings and Characters, Introduction to Objects and Methods, Formatting Numbers and Strings.	**8**

Control Structures: Selections: Introduction, Boolean Types, Values, and Expressions, **if** Statements, Two-Way **if-else** Statements, Nested **if** and Multi-Way **if-elif-else** Statements**,** Logical Operators, Conditional Expressions, **Loops**: Introduction, The **while** Loop, The **for** Loop, Nested Loops, Keywords **break** and **continue**	
Module – III **Functions:** Introduction, Defining a Function, Calling a Function, Functions with/without Return Values, Positional and Keyword Arguments, Passing Arguments by Reference Values, Modularizing code, The Scope of Variables, Default Arguments, Returning Multiple Values. **Lists:** Introduction, List Basics, Copying Lists, Passing Lists to Functions, Returning a List from a Function, Searching Lists, Sorting, Processing Two-Dimensional Lists, Passing Two-Dimensional Lists to Functions, Multidimensional Lists.	**8**
Module – IV **Tuples, Sets, and Dictionaries:** Introduction, Tuples: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Tuple methods, Sets: Creating Sets, Manipulating and Accessing Sets, Subset and Superset, Set Operations, Comparing the Performance of Sets and Lists, Dictionaries: Creating a Dictionary, Adding, Modifying, and Retrieving Values, Deleting Items, Looping Items, The Dictionary Methods.	**8**
Module – V **Objects and Classes:** Introduction, Defining Classes for Objects, Immutable Objects vs. Mutable Objects, Hiding Data Fields, Class Abstraction and Encapsulation, Object-Oriented Thinking. Inheritance and Polymorphism: Introduction, Super-classes and Subclasses, Overriding Methods, The **object** Class, Polymorphism and Dynamic Binding, The **isinstance** Function. Class Relationships: Association, Aggregation, composition. **Files and Exception Handling:** Introduction, text input and output: opening a file, Writing Data, Testing a File's Existence, Reading All Data from a File, Writing and Reading Numeric Data, Binary IO Using Pickling, Exception Handling, Raising Exceptions.	**8**

TEXT BOOKS:

1. Y. Daniel Liang, "Introduction to programming using python", Pearson Education; First edition (2017).

REFERENCE BOOKS:

1. Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education; Forth edition (2018)
2. Mark Lutz, "Learning Python" O′Reilly Fifth edition (2013).
3. Mark Summerfield, "Programming in Python 3: A Complete Introduction to the Python Language" Pearson Education; Second edition (2018).

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Working on real life project based on python programming.

POs met through Gaps in the Syllabus - 6, 9, 11 and 12

Topics beyond syllabus/Advanced topics/Design

1. Coverage of some third parties python libraries like: numpy, pandas etc
2. Graphical visualization using matplotlib library etc

POs met through Topics beyond syllabus/Advanced topics/Design - 4, 5, 8, and 11

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN225**
Course Title : **COMPUTER NETWORKS**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L: 3 T: 1 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives:
This course enables the students to:

A.	Have a broad understanding of computer network models, software and hardware.
B.	Learn different transmission mediums, digital and analog signals and their transmission techniques.
C.	Explore error detection and correction techniques, data link protocols and standards.
D.	Understand network layer and transport layer protocols.
E.	Implement and analyze routing and congestion issues in network design, Familiarize with network security, DNS, email and encryption algorithms.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand basic concepts of networks, network hardware and network software and describe various standard network models.
CO2	Understand data communication, various transmission media and familiarize with digital transmission and multiplexing techniques.
CO3	Analyze error detection and correction, data link protocols, understand the role of data link layer protocols.
CO4	Implement and analyze routing and congestion issues in network design.
CO5	Familiarize with network security, DNS and network management algorithms.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Uses of Computer Networks, Needs and Advantages, Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless networks. Network Topology: Star, Bus, Ring, Tree, Mesh and Hybrid. Network Software: Protocol Hierarchies, Design Issues for the Layers, Interfaces and services, Connection-Oriented Versus Connectionless Service. Reference Models: The OSI Reference Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models.	**8**
Module 2 **Physical Layer:** Transmission Media: Guided transmission media, wireless transmission, Communication satellites. Multiplexing: TDM, FDM, WDM. Analog	**8**

and Digital Signals: Characteristics and their transmission. Transmission impairment. Digital Transmission: Line coding, Block coding.	
Module 3 **Data Link Layer:** Services Provided to the Network Layer: Framing, Error Control, Flow Control. Error Detection and Correction: Error-Correcting Codes, Error-Detecting Codes. Elementary Data Link Protocols: Simplest, Stop-and-wait, Stop-and-wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ. HDLC Protocol. IEEE standard 802 For LANS And MANS: Ethernet, 802.4 – Token Bus, 802.5 – Token Ring) Working and frame formats. Wireless LANS: IEEE 802.11: Working and frame format.	**8**
Module 4 **Network Layer:** Logical Addressing: IPv4 addresses, IPv6 addresses. Need for network layer. Internet Protocol: IPv4, IPv6. Routing Algorithms: Unicast and Multicast routing Protocols. **Transport Layer:** Protocols: UDP, TCP. Congestion control.	**8**
Module 5 **Application Layer**: Domain Name System: Name Space, Distribution, DNS in the Internet, Resolution. **Network Management**: System, SNMP. **Network Security**: Cryptography: Introduction, Symmetric, Asymmetric. Security Services. Digital Signature.	**8**

TEXT BOOKS:

1. Forouzan, B., "Data Communication and Networking", TMH.
2. Andrew S Tanenbaum– ― Computer Networks‖ – PHI.

REFERENCE BOOKS:

1. William Stallings – ― Data and Computer Communications‖ – Pearson Education Asia, Seventh Edition,2001
2. Douglas E Comer - ―Computer Networks and Internets‖, -Pearson Education, 2014.
3. Larry L. Peterson, Bruce S Davie – ―Computer Networks: A Systems Approach‖, Fourth Edition,2007 (The Morgan Kaufmann Series in Networking)

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (Pos)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	2	2	2	1	1			2	2	3	3	3	3
CO2	3	2	2	2	2	1	1		2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	1		2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD6, CD7
CD3	Seminars	CO3	CD1, CD2, CD3, CD6, CD7
CD4	Mini Projects/Projects	CO4	CD1, CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD4, CD5, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	: **CN227**
Course Title	: **INTRODUCTION TO DATA SCIENCE**
Pre-requisite(s)	:
Co- requisite(s)	:
Credits:3 L: 3 T: 0	**P:0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: IV/2**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the fundamental concepts of data science.
B.	Understand the concept of Exploratory Data Analysis.
C.	Understand basics of Statistical methods.
D.	Know about the different types of regression techniques.
E.	Understand about inferential statistics and model evaluation.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Demonstrate key concepts related to Data Science.
CO2	Apply data pre-processing techniques.
CO3	Able to do exploratory data analysis on datasets.
CO4	Apply regression techniques.
CO5	Apply the inferential statistics.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction:** Definition, Data science in various fields, Facets of data, The data science process, The big data eco system and data science, An introductory working example of Hadoop.	**8**
Module 2 **Understanding Data**: Types of data – Numeric, Categorical, Ordinal. Classification of data: Structured, Semi-structured and Unstructured. Sources of data: Time series, Transactional data, Spatial Data, Social Network data – Date evolution. **Data Pre-processing:** Overview, Data cleaning, Data Integration and Transformation. Data Reduction. Data Discretization.	**8**
Module 3	**8**

Exploratory Data Analytics: Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics – ANOVA.	
Module 4 **Model development:** Regression models: Simple linear regression, least-squares principle, MLR, Multiple regression, Multiple correlation, Partial correlation, Model Evaluation using Visualization.	**8**
Module – 5 **Statistical Inference**: Developing Initial Hypotheses, Identifying Potential Data Sources, Testing hypotheses on means, proportions and variances. Model Evaluation: Cross-validation, Underfitting and Overfitting, Model selection.	**8**

TEXT BOOKS:
1. Davy Cielen, Arno D B Meysman, Mohamed Ali, "Introduction to Data Science", Dreamtech Press.
2. Gupta S.P. and Gupta M.P., Business Statistics, Sultan Chand & Sons.

REFERENCE BOOKS:
1. Hastie, Trevor, et al. "The elements of Statistical Learning", Springer.
2. Practical Statistics for Data Scientists, 2nd Edition, Peter Bruce, Andrew Bruce and Peter Gedeck.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment
1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	1	1	1	1	2	1	1	1	1	1	3	3	1	1
CO2	3	3	3	2	2	2	2	3	2	2	2	3	3	3	2
CO3	3	3	2	3	2	2	2	3	2	2	2	3	3	3	2
CO4	3	3	3	2	2	2	2	3	2	2	2	3	3	3	2
CO5	3	3	2	2	2	2	2	3	2	2	2	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD6, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN229**
Course Title : **INTRODUCTION TO ARTIFICIAL INTELLIGENCE**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the concepts of artificial intelligence.
B.	Understand the various types of searching methods used in AI problems.
C.	Learn about basic concepts of knowledge representation.
D.	Learn about reasoning in the uncertain domains.
E.	Understand the artificial neural networks.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand the various approaches of artificial intelligence and Intelligent agent.
CO2	Apply different search techniques for solving real world problems and finding solutions.
CO3	Representing knowledge using predicate logic and reasoning process.
CO4	Explain the concepts of reasoning in the uncertain knowledge domains.
CO5	Develop neural networks models for various applications.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Overview of Artificial Intelligence, Applications, Agent and Environment, Different types of Agents, Problem Space & Search, Problem Characteristics.	**8**
Module 2 Searching Techniques: Solving Problems by Searching, Problem Solving Agents, Uninformed Searching Strategies: BFS, DFS, Hill Climbing Search, Simulated Annealing Search, Informed Searching Strategies: Best First Search, A* Search.	**8**
Module 3 Using Predicate Logic: Types of Knowledge and Representation, Representing Simple Facts in Predicate Logic, Conversion to Clausal Form, Resolution, Forward Reasoning, and Backward Reasoning.	**8**

Module 4 Probabilistic Reasoning: Representing Domain in an Uncertain Domain, Truth Maintenance System, Default Reasoning and the Closed World Assumption, Bayesian Networks.	8
Module 5 Artificial Neural Networks: What is a Neural Network? Human Brain, Models of Neuron, Artificial Neural Network Architecture, Feed Forward and Feedback Network Architecture, Back Propagation Algorithm, Convolution Networks.	**8**

TEXT BOOKS:

1. Russel S. and Norvig P., "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson Education, 2010.
2. Rich E. & Knight K., "Artificial Intelligence", 3rd Edition, Tata McGraw-Hill Publishing Company Limited, 2008.

REFERENCE BOOKS:

1. Dan W. Patterson, "Introduction to Artificial Intelligence Expert Systems", Prentice Hall India New Delhi, 2006.
2. D. W. Rolston, "Principles of AI and Expert System Development", Tata McGraw-Hill Publishing Company Limited, 2015.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	1	2	2	1	1	2	2	1	2	2	3	2	2
CO2	3	2	2	1	3	1	1	1	2	1	2	2	3	2	3
CO3	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3
CO4	3	2	3	2	3	1	2	2	3	2	2	2	3	3	3
CO5	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD3, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD6, CD3, CD8
CD3	Seminars	CO3	CD1, CD3, CD6, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD3, CD6, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course code : **CN231**
Course title : **ENTERPRISE RESOURCE PLANNING**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L:3 T: 0 P: 0
Class schedule/week : **03**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Develop an understanding of ERP and its emerging trends.
B.	Explain the role of communication in ERP.
C.	Develop the knowledge on ERP and its related technologies.
D.	Explain mechanism for control, maintenance, and implementation of ERP and its life cycle.
E.	Explain the emerging trends of next generation enterprise.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Evaluate a good understanding of basic issues in Enterprise Systems.
CO2	Analyze the scope of common Enterprise Systems (e.g., MM, SCM, CRM, HRM, procurement.
CO3	Explain the challenges associated with implementing enterprise systems and their impacts on organizations.
CO4	Describe the selection, acquisition and implementation of enterprise systems.
CO5	Communicate and assess an organization's readiness for enterprise system implementation with a professional approach in written form.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 Overview of ERP Introduction of ERP, Need, Advantages, and Growth of ERP, MIS Integration, ERP drivers. Communication in ERP Systems: Enterprise Integration Application Tools for ERP, Network Structure of ERP System, ERP Work flow, Process modeling for ERP Systems.	**8**
Module 2 ERP and Related Technologies Business process Reengineering (BPR), Management Information System (MIS), Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing, Data Mining, Online Analytical Processing (OLTP), Supply Chain Management (SCM), Customer Relationship Management (CRM).	**8**

Module 3 Control and Maintenance of ERP Finance, Production planning, Sales and Distribution, Human Resource Management, Inventory Control System, Quality Management, ERP Implementation Life Cycles: Evaluation and selection of ERP package, Project planning, Implementation team training & testing, End user training & Going Live, Post Evaluation and Maintenance.	**8**
Module 4 ERP- Resource Management Perspective Business Modules in ERP Packages, Finance, Production, Human Resource, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution, Resource Management.	**8**
Module 5 Next generation enterprise Emerging trends, information mapping, role of centralized /distributed databases Linkages of the enterprise customer - enterprise, vendor enterprise, link within the enterprise and links with environment Client/server architecture.	**8**

TEXT BOOKS:

1. ERP Demystified, Alexis, Leon, Tata McGraw Hill.

REFERENCE BOOKS:

1. Enterprise Resource Planning, Shankar, Ravi & Jaiswal, S., Galgotia Publications.
2. Enterprise Resources Planning and Beyond. Langenalter, A. Gary, St. Lucie Press, USA.
3. Building the Customer Centric Enterprise, Imhoff, C. Loftis Lisa & Geiger, G. Jonathan John Wiley & Sons.
4. Enterprise Resource Planning: A Manager's Guide, Diwan, Parag & Sharma, Sunil, Excel Books

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	1	3	1	3	2	1	2	3	2	3	1	1	2	2
CO2	3	2	3	2	3	2	2	2	3	2	3	2	2	3	2
CO3	3	3	3	3	2	3	3	2	2	2	3	3	3	2	3
CO4	3	3	3	3	3	3	2	2	2	2	2	3	2	2	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3	2	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3
CD3	Seminars	CO3	CD1, CD2, CD4
CD4	Mini Projects/Projects	CO4	CD 1, CD2, CD3, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD4
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN222**
Course Title : **SOFTWARE ENGINEERING LAB**
Pre-requisite(s) :
Co- requisite(s) : **Software Engineering**
Credits: 2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **IV/2**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course envisions to impart to students to:

A.	Understand the concept of UML.
B.	Gain knowledge of various diagrams.
C.	Learn about software requirement specification.
D.	Gain knowledge about software design specification
E.	Learn about the relationships among different UML diagrams.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify the software requirement capturing process.
CO2	Elaborate knowledge about dynamic view of system.
CO3	Analyze about static view of software system.
CO4	Analysis about the relationship among static and dynamic view of system.
CO5	Identify the process of deployment of software system

Syllabus

List of Programs as Assignments

1. Draw use case diagram for online banking system.
2. Draw use case diagram for online library system
3 Draw use case diagram for online railway reservation system
4. Draw use case diagram for employee information system.
5. Draw use case diagram for inventory control system
6. Draw use case diagram for student information system
7. Draw use case diagram for online hotel management system.
8. Draw use case diagram for online bus reservation system.
9. Draw use case diagram for online Course registration system
10. Draw use case diagram for online teacher information system
11. Draw sequence diagram for online railway reservation system.
12. Draw sequence diagram for employee information system
13. Draw sequence diagram for inventory control system
14. Draw sequence diagram for student information system.
15. Draw sequence diagram for online hotel management system
16. Draw sequence diagram for online bus reservation system.
17. Draw sequence diagram for online course registration system
18. Draw sequence diagram for online teacher information system.

19. Draw activity diagram for online banking system.
20. Draw activity diagram for online library system.
21. Draw activity diagram for online railway reservation system.
22. Draw activity diagram for employee information system.
23. Draw activity diagram for inventory control system.
24. Draw activity diagram for student information system.
25. Draw activity diagram for online hotel management system.
26. Draw activity diagram for online bus reservation system.
27. Draw activity diagram for online course registration system
28. Draw activity diagram for online teacher information system
29. Draw class diagram for online banking system.
30. Draw class diagram for online library system
31. Draw class diagram for online railway reservation system
32. Draw class diagram for employee information system
33 Draw class diagram for inventory control system
34. Draw class diagram for student information system.
35. Draw class diagram for online hotel management system.
36. Draw class diagram for online bus reservation system.
37. Draw class diagram for online course registration system.
38. Draw class diagram for online teacher information system

TEXT BOOKS:

1. Mall Rajib, “Fundamentals of Software Engineering”, PHI, 2005.

REFERENCE BOOKS:

1. Pressman, “Software engineering A Practitioner’s Approach”, MGH**.**

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Apply testing strategies and handle software product maintenance issues.

POs met through Gaps in the Syllabus - 3, 4

Topics beyond syllabus/Advanced topics/Design

1. Translating design into coding.
2. Applying different testing strategies

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 4

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	3	2	2	1	2	2	2	1	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD4
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials		
	and Internets		
CD9	Simulation		

Course code	**: CN224**
Course title	**: PYTHON PROGRAMMING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Python Programming**
Credits: 2 L: 0 T: 0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: IV/2**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand computer programming concept using python language
B.	Explore basic data types, control structures and standard library functions.
C.	Explore the basic data structures: List, Tuple, Sets, Dictionaries available in python.
D.	Learning Object oriented concept of programming and its implementation in python.
E.	Handle disk data file for input output operations.

Course Outcomes

After the completion of this course, students will be able:

CO1	Solve the basic mathematical problem using python programming
CO2	Use basic data types control structures and utility functions from standard library for faster programming.
CO3	Use the basic and user defined data structures as per the need of problem.
CO4	Design and implement the problem using OOP concept of python.
CO5	Store, retrieve and manipulate data with disk file.

Syllabus

List of Programs as Assignments:

1. Write a program that displays "Hello to Python programming".
2. Write a program to read two integers and perform arithmetic operations on them (addition, subtraction, multiplication and division).
3. Write a program to read the marks of three subjects and find the average of them.
4. Surface area of a prism can be calculated if the lengths of the three sides are known.
5. Write a program that takes the sides as input (read it as integer) and prints the surface area of the prism (Surface Area = 2ab + 2bc + 2ca)
6. A plane travels 395,000 meters in 9000 seconds. Write a program to find the speed of the plane (Speed = Distance / Time).
7. You need to empty out the rectangular swimming pool which is 12 meters long, 7 meters wide and 2 meter depth. You have a pump which can move 17 cubic meters of water in an hour. Write a program to find how long it will take to empty your pool? (Volume = l * w * h, and flow = volume/time).
8. Write a program to convert temperature from centigrade (read it as float value) to Fahrenheit.
9. A car starts from a stoplight and is traveling with a velocity of 10 m/sec east in 20 seconds. Write a program to find the acceleration of the car. [acc = $(V_{final}-V_{initial})$/ Time].
10. Write a Program to Prompt for a Score between 0.0 and 1.0. If the Score Is Out of Range, Print an Error. If the Score Is between 0.0 and 1.0, Print a Grade Using the Following Table

i.

Score	Grade
>= 0.9	A
>= 0.8	B
>= 0.7	C
>= 0.6	D
< 0.6	F

11. Write a Program to find the maximum of three numbers.
12. Suppose you want to develop a program to play a lottery. The program randomly generates a two-digit number, prompts the user to enter a two-digit number, and determines whether the user wins according to the following rules:
    a) If the user's input matches the lottery in the exact order, the award is $10,000.
    b) If all the digits in the user's input match all the digits in the lottery number, the award is $3,000.
    c) If one digit in the user's input matches a digit in the lottery number, the award is $1,000.
13. Write a Program to Check If a Given Year Is a Leap Year.
14. Program to Find the GCD of Two Positive Numbers.
15. Write a program that prompts the user to enter a four-digit integer and displays the number in reverse order.
16. Write Python Program to Find the Sum of Digits in a Number
17. Write a program to print the sum of the following series.
18. 1 + 1/2 + 1/3 +. …. + 1/n
19. $1/1 + 2^2/2 + 3^3/3 + \ldots\ldots + n^n/n$
20. Write a Program to Display the Fibonacci Sequences up to nth Term Where n is Provided by the User.
21. Write a Program to Find the Sum of All Odd and Even Numbers up to a Number Specified by the User.
22. Write a Program to Check Whether a Number Is Prime or Not.
23. Write a Program to Find the Factorial of a Number.
24. Write a Program to Demonstrate the Return of Multiple Values from a Function Definition.
25. Program to Demonstrate the Use of Default Parameters
26. Write Program to Demonstrate the Scope of Variables.
27. Program to Print the Characters Which Are Common in Two Strings.
28. Write a program to check whether a given String is palindrome or not.
29. Write Python Program to Count the Number of Times an Item appears in the List.
30. Write a program to create a list of integer numbers. Sort the elements using any sorting method.
31. Write a program to create a lists of integer numbers and perform the linear and binary search.
32. Write a program to create a lists of cities names and perform the sort the cities name in alphabetical order.
33. Find Mean, Variance and Standard Deviation of List Numbers
34. Write a Program to Find the Transpose of a Matrix.
35. Write a program to perform the matrices multiplication.
36. Write a program to create a dictionary for countries name as key and currency as value. Traverse the dictionary with key: value Pairs in using for Loop.
37. Write a program to create tuples, and perform the following operations: Merging of tuples, Splitting of a tuple, comparison of two tuples.
38. Write a program to create an intersection, union, set difference, and symmetric difference of sets.
39. Write a program with "MyRectangle" class having the dimensions as data members and area() as a method member. Calculate the area of each rectangle object created by user.

40. Design a class with name “MyComplex” to represent the complex number including the constructor overloading, methods to perform the arithmetic operation over the two complex numbers. Write the complete python program for the above design.
41. Design a class with name “Distance” to represent the distance in feet and inch. Include the method to calculate the addition of two distances. Write the complete python program for the above design.
42. Write a complete program to implement the Employee and its subclasses (Salarayed Employee, DailyWaged Employee, Commission based employee) given in Hierarchical and multilevel manner. The program should exhibit the use of super key word to invoke the super class constructor.
43. Write a program to open a file and perform the reading and writing operation with the file.
44. Write a program to count the number of line in a file.
45. Write a program to count the frequencies of each word from a file.
46. Write a program to copy the text of a file to another file.
47. Write a program to append a file with the content of another file.
48. Write a program to compare two file.
49. Write a program to delete and insert a sentence at specified position in a file.
50. Write a program to delete a sentence from a file if the file contains a specific word.
51. Write program to delete comment lines from a file.
52. Write a program to capitalize each word of the file.
53. Write a program to handle an exception using exception handling mechanism of the python.
54. Write a program to raise an exception explicitly using raise keyword.

TEXT BOOKS:

1. Y. Daniel Liang, “Introduction to programming using python”, Pearson Education; First edition (2017).

REFERENCE BOOKS:

1. Martin C. Brown, “Python: The Complete Reference”, McGraw Hill Education; Forth edition (2018)
2. Mark Lutz, “Learning Python” O′Reilly Fifth edition (2013)
3. Mark Summerfield, “Programming in Python 3: A Complete Introduction to the Python Language” Pearson Education; Second edition (2018)

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

SEMESTER V

Course Code : **CN301**
Course Title : **FUNDAMENTALS OF COMPUTER ALGORITHMS**
Pre-requisite(s) : **Introduction to Data Structures**
Co- requisite(s) :
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **V/3**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand basic algorithm designing techniques such as recursion, greedy, dynamic programming and backtracking.
B.	Analyze the asymptotic performance of an algorithm.
C.	Demonstrate a familiarity with algorithms and data structures.
D.	Apply important algorithmic design paradigms and methods of analysis in solving real life problems.
E.	Synthesize efficient algorithms in common engineering design situations.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Have a clear understanding on solving the problems systematically.
CO2	Make use of linear and non-linear data structures, like, graphs and trees while designing algorithms.
CO3	Have a clear understanding of different design paradigms.
CO4	Analyze and measure the efficiency of an algorithm.
CO5	Demonstrate the basic knowledge of fundamentals of algorithms which would help them to take up an advanced course in the same field.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Definition of algorithm, **a**lgorithm design techniques, **a**nalysis of algorithms, performance analysis-time complexity, best**, w**orst and **a**verage cases, space complexity. **Asymptotic Notations:** O, Ω, Θ	**10**
Module 2 **Recursion:** Basic concept. Analysis of recursive algorithms, Master's theorem. **Divide & Conquer**: The general method. Binary search, merge sort, quick sort, best- and worst-case analysis, multiplication of large integers, Strassen's Matrix multiplication.	**10**
Module 3 **The Greedy Method:**	**10**

General Characteristics of greedy algorithms, problem solving using greedy methodology: Knapsack problem, Minimum Spanning trees (Kruskal's algorithm, Prim's Algorithm), single source shortest path problem (Dijkstra's algorithm), Huffman trees.	
Module 4 **Dynamic Programming**: The general method, principles of dynamic programming: memorization or iterations over sub problems, all-pairs shortest path problem, 0/1 Knapsack problem.	**10**
Module 5 **Basic Traversal and search techniques** on general graphs: BFS & DFS **Limitations of Algorithm Power:** **Backtracking method:** 4 -Queens problem, Sum of subset problems **Computational Intractability**: Overview of P, NP and NP-Complete Problems	**10**

TEXT BOOKS:

1. Jon Kleinberg and Eva Tardos. Algorithm Design. Pearson Education (Latest Edition).
2. Anany Levitin. Introduction to The Design and Analysis of Algorithms. Pearson Education (3rd Edition).

REFERENCE BOOKS:

1. Sahni Sartaj. Computer Algorithms. Computer Science Press (Latest Edition)
2. T. H. Cormen. Introduction to Algorithms. 3Ed.(International Edition) (MIT press)

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Polynomials and the FFT; Approximation Algorithms

POs met through Gaps in the Syllabus - 3, 4, 5

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1	3	2	3	1	1	2	2	2	2	2	2	2
CO2	3	2	1	2	3	2	3	1	2	3	1	1	2	2	2
CO3	2	3	3	2	2	2	1	2	3	2	3	3	2	2	2
CO4	2	3	3	2	1	2	3	3	2	3	2	3	2	2	3
CO5	2	3	2	2	2	2	3	1	2	2	3	2	2	2	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD3	Seminars	CO3	CD1, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self-learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN303**
Course Title	**: INTRODUCTION TO MACHINE LEARNING**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Machine Learning Lab**
Credits: 3 L:3 T:0	**P:0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: V/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Introduce the basic concepts and techniques of Machine Learning.
B.	Familiarize the concepts of regression models.
C.	Understand the concepts of feature selection and transformation techniques.
D.	Learn the utility of classification and clustering techniques.
E.	Identify machine learning algorithms for real-world problems.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the basic concepts required for machine learning.
CO2	Apply regression models for prediction.
CO3	Identification of discriminating features for better learning and apply classification algorithm.
CO4	Evaluate and analyze the performance of a machine learning algorithm or a system based on machine learning algorithm.
CO5	Apply artificial neural network for the real-world data.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Machine Learning, Types of Machine Learning: Supervised, semi-supervised and unsupervised learning. Basics of Linear Algebra - matrices and vectors, Eigen value decomposition.	**8**
Module 2 **Feature selection, Feature transformation:** Filter and Wrapper methods, Encoding schemes for data transformation, Principal component Analysis. **Supervised Learning:** Linear Regression: Prediction using Linear Regression, Linear Regression with one variable, Linear Regression with multiple variables.	**8**
Module 3	**8**

Logistic Regression: Classification using Logistic regression, Logistic regression vs. Linear regression, Logistic regression with one and multiple variables. **Classification:** Classification, Issues regarding classification, Techniques: Bayesian classification, Support Vector Machine, Decision Tree. Kernel trick	
Module 4 **Unsupervised Learning**: Clustering: Introduction, Partitioning- K-Means, Hierarchical - agglomerative and Divisive clustering. **Model Assessment and Selection:** Bias, Variance and model complexity, Bias – variance tradeoff, Bayesian approach and BIC, Cross-validation, Performance of Classification Algorithms (Confusion Matrix, Precision, Recall and ROC Curve). **Regularization:** Regularization and its utility: the problem of Overfitting, Application of Regularization.	**8**
Module 5 **Artificial Neural Networks**: Introduction, Model Representation, Perceptron, Forward propagation, Backpropagation algorithm, regularization and bias/variance. Recurrent networks.	**8**

TEXT BOOKS:

1. Alpaydin, Introduction to Machine Learning, Prentice Hall of India.
2. Mitchell Tom, “Machine Learning”, Latest Edition, Mc-Graw Hill.

REFERENCE BOOKS:

1. Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das, “Machine Learning”, Pearson Education India.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Application of machine learning in real life problems.

POs met through Gaps in the Syllabus – PO4, PO5

Topics beyond syllabus/Advanced topics/Design

1. Design of machine learning system to solve complex problems.
2. Capability to optimize machine learning models with applications in real-world use cases.

POs met through Topics beyond syllabus/Advanced topics/Design – PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	1	1	1	2	1	1	1	1	1	2	3	1	1
CO2	3	3	3	2	3	2	2	2	2	2	2	3	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2
CO4	2	3	2	3	3	2	1	1	2	2	1	3	3	3	2
CO5	3	3	3	3	3	2	2	2	2	2	2	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD5
CD3	Seminars	CO3	CD1, CD2, CD3, CD5, CD6, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD6
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN305**
Course Title : **COMPUTER GRAPHICS**
Pre-requisite(s) :
Co-requisite(s) : **Computer Graphics Lab**
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **V/3**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Acquire fundamental knowledge of the role of multimedia and graphics in computer science.
B.	Learn various object modeling algorithms and computations related to it.
C.	Learn to model and colour 2D and 3D objects.
D.	Learn to develop a simple Graphical User Interface.
E.	Learn to create realistic images using color and shading techniques.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Can perform visual computations for geometrical drawings.
CO2	Can model 2D objects.
CO3	Apply geometrical transformation of the modeled objects.
CO4	Can develop a simple Graphical User Interface.
CO5	Able to create realistic images using color and shading techniques.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction and Overview of Graphics Systems**: Overview of graphics systems, Application areas of Computer Graphics, Video Display Devices, Raster and Random Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard Copy Devices, and Graphics Software. Three-Dimensional Viewing Devices, Stereoscopic & Virtual Reality Systems.	**8**
Module 2 **Output Primitives**: Points and Lines, Line Drawing Algorithms (DDA and Bresenham's Algorithms), Circle Generating Algorithm, Filled Area Primitives – Scan-line Polygon Fill Algorithm, Inside-Outside Tests, Boundary-Fill Algorithm, Flood-Fill Algorithm, Color Tables.	**8**
Module 3 **2D Geometric Transformation:** Two-dimensional transformations and their matrix representations-Translation, Rotation, Scaling, Reflection, Shears, Homogeneous Coordinates, and Composite Transformations (Translations, Rotations, Scalings).	**8**

2D Viewing: The Viewing Pipeline, Viewing Coordinate Reference Frame, Window-to- Viewport Coordinate Transformation, Clipping- Point, Line Clipping -Cohen-Sutherland Line Clipping and Polygon Clipping -Sutherland- Hodgeman Polygon Clipping.	
Module 4 **3D Geometric Transformations and Viewing:** Translation, Rotation-Coordinate Axes Rotation, General 3-Dimensional Rotations, Rotations with Quaternions, Scaling, The Viewing Pipeline, Viewing Coordinates.	**8**
Module 5 **Color Models**: Properties of Light, Standard primaries and chromaticity diagram, XYZ color model, RGB color model, YIQ color model, HSV color model, HLS color model **Visible Surface Detection Method:** Classification of visible surface detection algorithm, Back Face Detection, Depth- Buffer method, A-Buffer method, and Scan line method.	**8**

TEXT BOOKS:

1. D. Hearn and M. P. Baker, "Computer Graphics: C Version", 2nd Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. FoleyJ. D., DamA. Van, Feiner S. K., and Hughes. F., "Computer Graphics: Principles and Practice in C", 3rd Edition, Pearson Education, 2013.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2, or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as the use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN307**
Course Title : **WEB PROGRAMMING**
Pre-requisite(s) :
Co- requisite(s) : **Web Programming Lab**
Credits: 3 L: 3 T:0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **V/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn about basics of web programming.
B.	Learn HTML, Java Script, XML for scripting.
C.	Learn web-based programming using ASP.NET.
D.	Learn PHP based programming.
E.	Learn Making static and dynamic websites.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand the elements of HTML and design static web pages.
CO2	Get familiarized with .net framework.
CO3	Develop interactive web pages using XML.
CO4	Design dynamic website using ASP.net.
CO5	Learn basics of PHP and apply it to develop dynamic websites.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Introduction to Internet and HTML: Introduction to Internet, Internet Services, Web Server, Web Client, Domain Registration, Internet Security. HTML Tags, HTML Documents, Header Section, Body Section, Headings, Link Documents using Anchor Tag, Formatting Characters, Font tag, Images and Pictures, Listing, Tables in HTML, HTML iframes, HTML Forms.	**8**
Module 2 JavaScript: Use of JavaScript in Web Pages, Advantages of JavaScript, Data Types, Variables, Operators and Expressions, Conditional Statements, Array Objects, Date Objects, String Objects, Type Casting, Functions, DOM. Introduction to Javascript Frameworks, Library and Runtime Environment: React, Angular, Node.js, Express.js.	**8**
Module 3 Understanding XML: Overview of XML, XML Families of Technology, Creating XML Documents, Rules for Well-Formed XML, Discerning Structure, Working	**8**

with Mixed content, Adding Comments, CDATA Sections, Creating a DTD-The Concept of a Valid XML Document, Creating a DTD for an existing XML File.	
Module 4 ASP .NET: Building Web Forms Using ASP .NET, Exploring ASP .NET Server Controls, Using ASP.NET Server Controls to Create Web Forms, Understanding the Code behind the Page. Using Validation Controls to Improve Web Forms.	**8**
Module 5 PHP: Preparing the Use PHP, Exploring PHP for the First Time, Understanding PHP Basics, Displaying PHP Output, Managing PHP Program Flow. Planning a PHP Web Application, Creating and Using a Logon Window, Managing System Data, Updating a PHP Web Application.	**8**

TEXT BOOKS:

1. Xavier C., "Web Technology & Design", New Age International Publishers, New Delhi.
2. Bai Xue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, Kaparthi Shashi, Macintyre Peter, Morrissey Bill, "The Web Warrior Guide to Web Programming", India Edition, Thomson Education.
3. Steven Holzner, ―PHP: The Complete Reference, McGraw Hill Education Pvt Ltd.

REFERENCE BOOKS:

1. Dr. Ravinder Singh, Amit Gupta, ―Magic with HTML, DHTML and Javascript, Laxmi Publications, First Edition, 2009.
2. Herbert Schildt, ―C# 4.0 : The Complete Reference, Tata McGraw Hill.
3. MacDonald, ―The Complete Reference ASP.NET, Tata McGraw Hill.
4. Matt Doyle, ―Beginning PHP 5.3, Wiley Publishing, 2010

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	2	2	2	1	1	2	1	2	2	3	3	3	3
CO2	3	2	2	2	2	1	1	2	2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	1	2	2	3	2	3	3	3	3
CO4	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD7
CD3	Seminars	CO3	CD2, CD3, CD6, CD7
CD4	Mini Projects/Projects	CO4	CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD5, CD6, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN309**
Course Title	**: SOFTWARE TESTING**
Pre-requisite(s)	**: Software Engineering**
Co- requisite(s)	**:**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: V/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Have a broad understanding of software requirements in context to end user expectations.
B.	Familiarize with testing environments and test processes.
C.	Describe to the students the impact and methods to overcome programming errors.
D.	Devise strategies to detect and rectify common programming errors.
E.	Conceptualize the role of testing in estimating software quality.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the types and effects of errors and bugs on a software and the testing process.
CO2	Apply testing strategies to detect software bugs.
CO3	Analyze approaches of verification and validation including static analysis, and reviews as well as software testing approaches such as unit testing and integration testing.
CO4	Evaluate the software quality and apply test suites like JUnit and selenium fortesting software.
CO5	Summarize best practices for coding to ensure good quality software, quality products by applying quality metrics.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Introduction: Software Testing – Psychology of Testing, Verification and Validation, Testing Team and Development Team, Characteristics of Test Engineers, Levels of Testing Principles of Software Testing, Error, Fault, Failure, Incident, Error and Fault Taxonomies, Test Cases, Limitations of Testing Code inspections, desk checking, group walkthroughs and peer reviews. Overview of Graph Theory for tester.	**8**

Module 2 Functional Testing: Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique. Structural Testing: Path testing, DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Slice based testing.	**8**
Module 3 Testing Activities: Unit Testing, Levels of Testing, Integration Testing, System Testing, Debugging, Regression Testing, Extreme Testing.	**8**
Module 4 Object Oriented Testing: Issues in Object Oriented Testing, Class Testing, GUI Testing, Object Oriented Integration and System Testing. Testing Internet applications: Overview, challenges and strategies of testing internet applications.	**8**
Module 5 Overview of Testing Tools – Need for Automated Testing Tools, Taxonomy of Testing Tools, Functional/Regression Testing Tools, Performance Testing Tools, Testing Management Tools, Source Code Testing Tools, How to select a Testing Tool. WinRunner – Overview of WinRunner, Testing Applications using WinRunner.	**8**

TEXT BOOKS:

1. Jorgensen Paul C., "Software Testing- A Craftsman's Approach", Second Edition, CRC Press, 2008.
2. Ammann Paul and Offutt Jeff, "Introduction to Software Testing", Cambridge University Press, Cambridge,UK, ISBN 0-52188-038-1, 2008.

REFERENCE BOOKS:

1. Tamres Louise, "Software Testing", Pearson Education Asia, 2002.
2. Pressman Roger S., "Software Engineering – A Practitioner's Approach", Fifth Edition, McGraw-HillInternational Edition, New Delhi, 2001.
3. Aggarwal K.K. & Singh Yogesh, "Software Engineering", New Age International Publishers, New Delhi,2003 4. Tamres Lauise, "Introducing Software Testing", Pearson Education

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Combination of manual and automated testing.

POs met through Gaps in the Syllabus - 3, 5, 12

Topics beyond syllabus/Advanced topics/Design

1. Testing for emerging applications such as Machine learning, Big data etc.
2. Digital transformation with Agile.

POs met through Topics beyond syllabus/Advanced topics/Design - 5, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	3	2	3
CO2	3	3	3	1	3	1	1	1				2	2	3	2
CO3	3	3	3	3	3	1	2	2		1	1	2	3	2	3
CO4	3	3	3	1	3		1	1		1	1	2	3	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN304**
Course Title	**: MACHINE LEARNING LAB**
Pre-requisite(s)	**: Python Programming Lab**
Co- requisite(s)	**: Introduction to Machine Learning**
Credits: 2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: V/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Make use of datasets in implementing the machine learning algorithms.
B.	Understand the basic concepts and techniques of machine learning through programming.
C.	Develop skills of machine learning packages for solving practical problems.
D.	Understand the importance of feature selection and feature transformation.
E.	Implement machine learning concepts and algorithms in any language.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the implementation procedures for the machine learning algorithms.
CO2	Understand the features of data to apply on real-world problems.
CO3	Apply appropriate datasets to the machine learning algorithms.
CO4	Perform machine learning experiments to solve real-world problems.
CO5	Predict/classify using machine learning algorithms.

Syllabus

List of Programs as Assignments:

1. Introduction to the language – Importing datasets – Data visualization.
2. Implement Linear Regression problem. For example, based on a dataset comprising of existing set of prices and area/size of the houses, predict the estimated price of a given house.
3. Based on multiple features/variables perform Linear Regression. For example, based on a number of additional features like number of bedrooms, servant room, number of balconies, number of houses of years a house has been built – predict the price of a house.
4. Implement a classification/ logistic regression problem. For example, based on different features of student's data, classify, whether a student is suitable for a particular activity. Based on the available dataset, a student can also implement another classification problem like checking whether an email is spam or not.
5. Use some function for regularization of dataset based on problem 4.
6. Use some function for neural networks, like Stochastic Gradient Descent or backpropagation - algorithm to predict the value of a variable based on the dataset of problem 4.
7. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
8. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a CSV file.
9. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Calculate the accuracy, precision, and recall for your data set.

10. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
11. Implement dimensionality reduction using PCA method.
12. Implement classification using SVM to classify emails into spam or non-spam categories.
13. Apply K-Means algorithm to cluster similar documents together.
14. Implement agglomerative and divisive clustering approach.
15. For a given dataset, analyze which regression model performs better.

TEXT BOOKS:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems by Aurélien Géron.
2. C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Industry oriented projects.

POs met through Gaps in the Syllabus – PO2, PO4

Topics beyond syllabus/Advanced topics/Design

1. Analysis of Time series data and Stream data.

POs met through Topics beyond syllabus/Advanced topics/Design – PO4

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	1	1	1	1	1	1	1	1	1	2	3	1	1
CO2	3	2	2	2	1	1	1	1	1	1	1	2	3	1	1
CO3	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD5, CD8, CD9
CD2	Tutorials/Assignments	CO2	CD5, CD9
CD3	Seminars	CO3	CD5, CD9
CD4	Mini Projects/Projects	CO4	CD5, CD6, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD5, CD6, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN306**
Course Title	**: COMPUTER GRAPHICS LAB**
Pre-requisite(s)	**:**
Co-requisite(s)	**: Computer Graphics**
Credits:2 L:0 T:0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: V/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn computer graphics by practical.
B.	Learn to code for various graphics tools.
C.	Learn the various theory by implementation using programming.
D.	Identify the limitations of C Language for graphics-related problems.
E.	Know the practical application of computer graphics.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Code programs efficiently.
CO2	Translate the graphics algorithm to programs.
CO3	Test and execute the graphical syntax and logical errors.
CO4	Apply programming to solve simple graphical problems using functions.
CO5	Write the C program efficiently for transformation problems.

Syllabus

List of Programs as Assignments:
Write a program
1. To get the background color.
2. To set the background color.
3. To plot a point of co-ordinate (100,100).
4. To draw a line using the line function.
5. To draw a line using the line function. take the end coordinates from the user.
6. To draw a triangle using the polygon function.
7. To draw a polygon of ‘n’ edges using the polygon function.
8. To draw a polygon of ‘n’ edges taken from the user using the polygon function.
9. To draw a circle using the circle function.
10. To draw a circle of radius ‘r’ taken from the user using the circle function.
11. To draw a line using the DDA algorithm.
12. To draw a line using Bresenham’s line algorithm.
13. To draw a circle using the Midpoint circle algorithm.
14. To draw a line using Bresenham’s line algo, where endpoints are taken from the user.
15. To draw a line using DDA algo, where endpoints are taken from the user.
16. To draw ‘n’ concentric circles taken from the user using the midpoint algorithm.
17. Write a program to implement polygon filling.
18. To create a line and translate it.

19. To create a line and increase its size with a value taken from the user.
20. To create an equilateral triangle.
21. To draw a line and rotate it with an angle of 45.
22. To create a circle and translate it.
23. To create a circle and translate it with a value taken from the user.
24. To create an equilateral triangle and rotate it with an angle of 45.
25. To create an equilateral triangle and create reflection.
26. To scale a rectangle.
27. To shear a rectangle. take the shear factor from the user.
28. To create an equilateral triangle and translate, rotate, and scale it.
29. To draw a line with shear and translation.
30. Write a Program to study 3-D transformations.

TEXTBOOKS:

1. D. Hearn and M. P. Baker, "Computer Graphics: C Version", 2nd Edition, Pearson Education, 2013.
2. Roger T. Stevens, Advanced Graphics Programming in C and C++, BPB Publication

REFERENCE BOOKS:

1. Foley J. D., Dam A. Van, Feiner S. K., and Hughes. F., "Computer Graphics: Principles and Practice in C", 3rd Edition, Pearson Education, 2013.
2. S. Harrington -Computer Graphics- A Programming Approach, McGraw Hill Publication, New Delhi, 1994.
3. J.D. Foley et. al- A Fundamental of Computer Graphics Addition Wesley, London, 1993

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN308**
Course Title : **WEB PROGRAMMING LAB**
Pre-requisite(s) :
Co- requisite(s) : **Web Programming**
Credits: 2 L:0 T:0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **V/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn about basics of web programming.
B.	Learn HTML, Java Script, XML for scripting.
C.	Learn web-based programming using ASP.NET.
D.	Learn PHP based programming.
E.	Learn Making static and dynamic websites.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Know the fundamentals of web programming.
CO2	Identify .NET technology and framework.
CO3	Elaborate on the web-based programming.
CO4	Perform web-based programming.
CO5	Design static and dynamic websites.

Syllabus

List of Programs as Assignments:
1. Design simple HTML pages to illustrate Ordered, Unordered¬ & Definition Lists Tables¬ Frames¬ Form elements¬
2. Web page validation using Java script.
3. Create web page using CSS.
4. Event handling using DHTML.
5. Demonstrate the significance of cookies using PHP.
6. Develop a home page for a website using PHP.
7. Demonstrate Constructor Overloading.
8. Demonstrate Method Overloading.
9. Demonstrate Method Overriding.
10. Demonstrate Multilevel Inheritance.
11. Demonstrate Delegates and Events.
12. Create a web page to demonstrate server controls in asp.net.
13. Demonstrate validation controls in asp.net.
14. Develop web application to view and update data in database.
15. Create a web application to view and delete data in database.
16. Develop web application to insert data in to database.
17. India is a large country. Different regions observe variations in climate. The spoken language of one state is quite different from that of another. They wear different types of garments. They celebrate different festivals and perform varied religious rites. People belonging to diverse cultures

belong to different religious faiths. In spite of these diversities, Indians feel a sense of unity and oneness among them. Thus, we conclude that India is a land of Unity in Diversity.
a) All the headings should be H2 and green colour.
b) Main heading should be H1 and centre aligned.
c) The background should be yellow colour.
d) There are 10 paragraphs so each of them should be made using P tag.
e) The Introduction and Conclusion paragraphs should have "Times New Roman" font, the size should be 12 and colour should be blue.
f) All the remaining paragraphs text should be pink and magenta coloured in an alternate way.
g) There should be one meaningful picture in the web page with specific dimension.
18. Create a webpage having a list as shown below: • Food . Fruit Apple Mango *Vegetable Potato Tomato Carrot • Dress Ethnic wear Kurta Sherwani Western wear suit jeans • Sports a. Indoor sports carom table tennis b. Outdoor sports Cricket Hockey
19. Create a webpage with the following: a) A superscript and subscript tag b) Pre tag c) Paragraph tag d) Anchor tag Page 91 of 243 e) Image tag f) Definition list tag g) Marquee tag h) Horizontal line tag i) Break tag j) Heading tag
20. Create a webpage having 10 divisions each having separate background color and text color using tag. At the top right corner there should be an image hyperlink opening in a new webpage.
5. Create a webpage with a form loaded into it and take input of three strings through three textboxes and then concatenate them without using any built-in function.
21. Create a webpage with two tables. First one should have 1 row and 5 columns and the second one with 3 rows and 4 columns. The contents of the first table should be center aligned and contents of the second table should be right aligned. Each column of the first table should have separate colors and each row of the second table should have separate colors.
22. Write a JavaScript program to calculate and display the aggregate and percentage of three subjects' (Physics, Chemistry and Mathematics) marks along with the name of a student. The name and individual marks input shall be taken by textbox in the webpage.
23. Write a JavaScript program to search the element 4 in the array [2, 6, 4, 10, 4, 0, -2] using any method.
24. Create a framed webpage with different frames as below: 1 2 3 4 5 6 7 8 Contents of 1st, 3rd, 5th, 7th frame should be same again 2nd, 4th, 6th and 8th should be same.
25. Write a JavaScript program to calculate the percentage of three subjects' (English, Mathematics, and Science) marks along with the name of a student. The name and individual marks input shall be taken by form in the webpage.
26. Create a webpage to take input of two strings and concatenate them without using any builtin function.
27. Write a JavaScript program to calculate and display the aggregate and percentage of three subjects' (Physics, Chemistry and Mathematics) marks along with the name of a student. The name and individual marks input shall be taken by textbox in the webpage.

TEXT BOOKS:

1. Bai Xue, Ekedahl Michael, Farrell Joyce, Gosselin Don, Zak Diane, Kaparthi Shashi, MacintyrePeter, Morrissey Bill, "The Web Warrior Guide to Web Programming", India Edition, Thomson Education.
2. Xavier C., "Web Technology & Design", New Age International Publishers, 1st Edn, New Delhi, 2004.

REFERENCE BOOK

1. Ross Ivan Bay, "Web Enable Commercial Application Using HTML, DHTML", BPB Publication.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Detailed learning of HTML and XHTML
2. Detailed learning of JavaScript
3. Detailed learning of XML

POs met through Gaps in the Syllabus 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Concepts of XSLT
2. Knowledge about Active Server Pages
3. Designing interactive server pages

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	1	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	
CD2	Tutorials/Assignments	CO2	
CD3	Seminars	CO3	
CD4	Mini Projects/Projects	CO4	
CD5	Laboratory Experiments/Teaching Aids	CO5	
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

SEMESTER VI

Course Code : **CN331**
Course Title : **ADVANCED JAVA PROGRAMMING**
Pre-requisite(s) : **Java Programming**
Co- requisite(s) : **Advanced Java Programming Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VI/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Build GUI interfaces for user interaction.
B.	Connect database with front end applications.
C.	Understand various mechanisms to apply constraint in the applications.
D.	Explain the existing classes and objects/group of objects.
E.	Build different applications.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Construct different applications using Swing.
CO2	Connect the database to build frontend-backend based applications.
CO3	Incorporate constraints and conditional statements using JSP.
CO4	Encapsulate many objects into a single object.
CO5	Extend the capabilities of servers that host applications accessed by means of a request-response programming model.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Swing: Origin, Basics concepts of AWT, Two key swing features, The MVC connection, Components and Containers, The Swing packages, Event Handling, Create a Swing Applet, Painting in Swing.	**8**
Module 2 Exploring Swing: JLabel and ImageIcon, JTextField, The Swing Buttons, JTabbedPane, JScrollPane, JList, JComboBox JDBC: Introduction, JDBC Driver, Database Connectivity, Access with and without DSN.	**8**
Module 3 JSP: Lifecycle of JSP, JSP API, JSP Scripting elements: Scriplet tag, Expression tag, Declaration tag, Use of Implicit Objects: JSP Request, JSP Response, JSP Config, JSP Session, JSP Exception, JSP Directive elements	**8**

Module 4 Java Beans: Advantages of Java Beans, Introspection-Design patterns for properties and events, Methods, use of the BeanInfo Interface, Bound and Constrained properties, Persistence, Customizers Java Beans API: Introspector, PropertyDescriptor, EventSetDescriptor, MethodDescriptor	**8**
Module 5 Servlets: Background, The life cycle of Servlet, Servlet Development options, Using Tomcat, The Servlet API, using Cookies, Session Tracking	**8**

TEXT BOOKS:

1. Kamakhya Narain Singh, Rashmi Kanta Das, A TEXT BOOK ON ADVANCED JAVA, SCITECH.
2. Herbert Schildt, Java - The Complete Reference, Ninth Edition, Oracle Press.

REFERENCE BOOKS:

1. Uttam Roy, ADVANCED JAVA PROGRAMMING, Oxford University Press.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Implementation of frontend-backend based applications

POs met through Topics beyond syllabus/Advanced topics/Design - PO2, PO3, PO4, PO11

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	2	3	1	1	1	1	1	2	1	3	1	2	1	1
CO2	2	1	2	2	1	1	1	1	1	1	2	1	1	1	1
CO3	1	2	2	2	1	1	1	1	2	1	2	1	2	1	1
CO4	2	1	2	2	1	1	1	1	2	1	2	1	2	1	1
CO5	2	2	2	2	1	1	1	1	1	1	2	1	2	2	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low)   2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD4, CD5
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN333**
Course Title : **DATA ANALYTICS**
Pre-requisite(s) :
Co- requisite(s) : **Data Analytics Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VI/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand business intelligence and data analytics.
B.	Understand the methods of pre-processing data and performing activates related to data analytics.
C.	Know the various applications of data analysis.
D.	Know the business data analysis through the powerful tools of data analytics.
E.	Choose data analysis techniques.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Illustrate about business intelligence and data analytics.
CO2	Explore different aspects of data analysis technologies.
CO3	Elaborate the methods of data mining and creation of decision tree.
CO4	Implement data analysis through the powerful tools of data application.
CO5	Apply R to implement various data analytics methods.

Syllabus

MODULES	(NO. OF LECTURE HOURS)
Module 1 Introduction to data analytics and its applications, Overview of the data analytics process. use of programming languages and tools for data analytics, Analysis using Descriptive and Pictorial Statistics: mean, median, mode, harmonic mean, geometric mean, variance and standard deviation, quantiles, skewness, moments and kurtosis.	**8**
Module 2 Data Relationships, Transformation, and Data Cleaning: Relationships between different types of data: Relationship between two categorical data, Relationship between categorical and quantitative data, Relationship between two quantitative data Transformation: The logarithm transformation, Root and square root transformation Standardization (Z-transformation), Min-max normalization. Data cleaning: missing values, noisy data.	**8**
Module 3	**9**

Analysis using Inferential Statistics: Sampling, Sampling Distribution, and Estimation of Parameters, Sampling distribution of: means, proportions, difference of means, difference of proportions. Hypothesis testing about: population mean, the difference between two means, about a population proportion, difference between two proportions.	
Module 4 Advanced Topics in Data Analytics: Time series analysis and forecasting Text mining, Text data analysis and informational retrieval. Dimensional reduction for text. natural language processing, Social network analysis, Mining on social networks, Characteristics of social network, Link mining Tasks and challenges.	**9**
Module 5 Data Visualization, Principles of data visualization, Visualization libraries and tools, Effective visualization techniques for different data types.	**6**

TEXT BOOKS:

1. Gupta and Gupta, "Business Statistics", Sultan Chand and Sons, 2014.
2. Bishnu and Bhattacherjee, Data Analysis: Using Statistics and Probability with R Language, PHI Learning, 2019.
3. Han J and Kamber M, "Data Mining: Concepts and techniques", Morgan Kaufmann Publishers.

REFERENCE BOOKS:

1. Maheshwari Anil, "Data Analytics", Mc Graw hill publication, 2017.
2. TanPang-Ning, SteinbachMichael, and KumarVipin, "Introduction to Data Mining, PearsonEducation", New Delhi.Dunham
3. H.M. & Sridhar S., "Data Mining", Pearson Education, New Delhi, 2006.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Use of various data to implement all the data analysis concepts.
2. Interaction with domain knowledge concepts with the actual algorithmic implementation.
3. Handling real data using data analytics algorithms.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	1	3	3	1	3	1	1	1	1	2	1	2	2	2	3
CO2	3	2	3	1	3	3	1	2	1	1	1	2	3	2	2
CO3	1	3	3	3	3	1	2	1	1	1	1	2	2	2	2
CO4	3	2	2	1	3	1	2	2	2	1	1	2	2	3	2
CO5	1	3	3	3	3	1	1	1	2	2	1	2	2	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD6, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	:	**CN335**
Course Title	:	**DISTRIBUTED COMPUTING**
Pre-requisite(s)	:	**Basics of Operating Systems & Computer Networks**
Co- requisite(s)	:	
Credits: 3 L: 3 T: 0		**P:0**
Class schedule per week	:	**03**
Class	:	**BCA**
Semester / Level	:	**VI /3**
Branch	:	**Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Know about Different forms of Computing.
B.	Understand Interprocess Communications.
C.	Learn and understand Distributed Computing Paradigms.
D.	Know about The Client Server Paradigm.
E.	Implement Distributed Objects.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Justify the presence of concurrency within the framework of distributed system.
CO2	Explain the range of requirements that modern distributed systems must address.
CO3	Describe how the resources in a parallel and distributed system are managed by software.
CO4	Understand the memory hierarchy and cost-performance trade-offs.
CO5	Explain what virtualization is and how it is realized in hardware and software.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1: **Distributed Computing- An Introduction:** Definitions, The History of Distributed Computing, Different Forms of Computing, The Strengths and Weaknesses of Distributed Computing, Basics of Operating Systems, Network Basics, Software Engineering Basics. **Interprocess Communications:** An Archetypal IPC Program Interface, Event Synchronization, Timeouts and Threading, Deadlocks and Timeouts, Data Representation, Data Encoding, Text Based Protocols, Request-Response Protocols, Connection-Oriented versus Connectionless IPC.	**8**
Module 2 **Distributed Computing Paradigms:** Paradigms and Abstraction, Paradigms for Distributed Applications, Trade-offs. **The Socket API:** Background, The Socket Metaphor in IPC, The Datagram Socket API, The Stream- Mode Socket API, Sockets with Nonblocking I/O Operations, Secure Socket API.	**8**

Module 3 **The Client-Server Paradigm:** Background, Client-Server Paradigm Issues, Software Engineering for a Network Service, Connection-Oriented and Connectionless Servers, Iterative Server, and Concurrent Server, Stateful Servers.	**8**
Module 4 **Group Communication:** Unicasting versus Multicasting, An Archetypal Multicast API, Connectionless versus Connection-Oriented Multicast, Reliable Multicasting versus Unreliable Multicasting, The Java Basic Multicast API, Reliable Multicast API.	**8**
Module 5 **Distributed Objects:** Message Passing versus Distributed Objects, An Archetypal Distributed Object Architecture, Distributed Object Systems, Remote Procedure Calls, Remote Method Invocation, Client Callback, Stub-downloading, RMI Security Manager Advanced Distributed Computing Paradigms.	**8**

TEXTBOOKS:

1. M. L. Liu, "Distributed Computing, Principles and Applications", Pearson Education.

REFERENCE BOOKS:

1. Altiya H., Welch J., "Distributed Computing Fundamentals, Simulations and Advanced Topics", 2nd edition, Wiley – India Edition, 2006.
2. Distributed Computing, S. Mahajan and S. Shah, Oxford University Press.
3. Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshema kalyani and Mukesh Singhal, Cambridge, 2010.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design.

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN337**
Course Title	**: INTRODUCTION TO DATA MINING**
Pre-requisite(s)	**: Database Management Systems**
Co- requisite(s)	**:**
Credits: 3 L:3 T: 0	**P:0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester /Level	**: VI/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Learn about data mining Concepts and study the different data mining tasks and issues.
B.	Introduction to data warehouse and basic operations for identifying similarities between data objects.
C.	Know the various techniques for data pre-processing.
D.	Familiarize the concepts of classification and clustering.
E.	Decide how to evaluate a model.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Identify data mining related applications, tasks and issues.
CO2	Understand the concept of data warehouse and similarity dissimilarity measures.
CO3	Mathematically perform pre-processing operations on datasets to ensure the validity of the data is improved.
CO4	Understand the algorithms of classification and clustering.
CO5	Analyse and evaluate algorithms.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1: **Data Mining:** Introduction, Relational Databases, Data Warehouses, Data Mining, Tools of data mining, Applications of data mining, Transactional databases, Advanced database Systems, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining.	**8**
Module 2 **Data Warehouse:** Introduction, A Multidimensional data Model, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology, From Data warehousing to Data Mining. OLTP system, OLAP, types of OLAP, different types of schema and measures, DMQL **Measures of Similarity and Dissimilarity**: Basics. Similarity and Dissimilarity between Simple Attributes. Dissimilarities between Data Objects. Similarities between Data Objects.	**8**

Module 3 **Data Processing**: Data Cleaning: Missing values, Noisy data Data cleaning as a process. Data Integration: Entity identification problem, Redundancy detection using Correlation. Data Transformation: Discretization, Normalization and concept Hierarchy Generation. Data Reduction: Numerosity reduction – Histogram, clustering, sampling.	**8**
Module 4 **Classification:** Basic Concepts and Techniques. Decision Tree Classifier. A Basic Algorithm to Build a Decision Tree. Measures for Selecting an Attribute Test Condition. Algorithm for Decision Tree Induction. **Cluster Analysis:** Basic Concepts and Algorithms. Different Types of Clustering. Different Types of Clusters. K-means. Basic K-means Algorithm.	**8**
Module 5 **Model Evaluation:** Metrics for evaluating classifier performance, Cross-validation, ROC curve. **Association Analysis**: Basic Concepts and Algorithms Preliminaries. Frequent Itemset Generation. The Apriori Principle. Frequent Itemset Generation in the Apriori Algorithm. Candidate Generation and Pruning Support Counting. Rule Generation.	**8**

TEXT BOOKS:

1. Tan Pang-Ning, Steinbach Michael, and Kumar Vipin, "Introduction to Data Mining", Pearson Education, New Delhi.
2. Data Mining: Introductory and Advanced Topics: M.H. Dunham, Pearson Education.

REFERENCE BOOKS:

1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques Publisher Harcout India. Private Limited.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Use of massive data to implement all the data mining concepts.
2. Handling various data using same data mining algorithms.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Text Mining, Outlier Mining
2. Advanced clustering algorithms

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	2	2	1	2	2	2	2	1	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN339**
Course Title : **INTERNET OF THINGS**
Pre-requisite(s) : **Computer Networks**
Co- requisite(s) : **Internet of Things Lab**
Credits:3 L:3 T:0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VI/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Learn about the basic concepts of IoT.
B.	Learn the present state of technology of IoT architecture.
C.	Get to know various types of IoT Protocols.
D.	Learn about Data Analytics in the field of IoT.
E.	Learn and evaluate different applications of IoT is Smart City concept.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Identify different parts of IoT and their uses.
CO2	Explain the IoT architectures and their functions.
CO3	Demonstrate the role of Wireless sensor network and Smart objects and in the field of IoT.
CO4	Identify the emerging research challenges in the field of IoT.
CO5	Design basic IoT application.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 What Is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges IoT Network Architecture and Design: Drivers behind New Network Architectures, Comparing IoT architectures, A Simplified IoT Architecture.	**9**
Module 2 Smart Objects, The Things of IoT: Sensors, Actuators and Smart objects, Wireless Sensor Networks, Connecting Smart Objects: Communications criteria, IoT Access Technologies.	**8**
Module 3 IP as the IoT Network Layer: Business Case of IP, Need for Optimization, Optimizing IP for IoT, Profiles and Compliances.	**9**

Module 4 Application Protocols for IoT: The Transport Layer, IoT Applications Transport methods, SCADA, Generic web-based protocols, COAP, MQTT, Introduction to Data Analytics for IoT, Structured and Unstructured Data, IoT Data Analytics Overview and Challenges.	**8**
Module 5 Case Studies/Industrial Applications: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment's.	**6**

TEXT BOOKS:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press.

REFERENCE BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-on-Approach)", University Press India Pvt. Ltd.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education (Cisco Press Indian Reprint).
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Education.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN341**
Course Title : **INTRODUCTION TO COMPUTER OPTIMIZATION TECHNIQUES**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L:3 T: 0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VI/3**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Learn about models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).
B.	Formulation of mathematical models for quantitative analysis of managerial problems in industry.
C.	The problem formulation by using linear programming Problems, Transportation Problems, Assignment Problems
D.	To develop variety of models for making appropriate decisions.
E.	Develop mathematical skills to analyze and solve network models arising from a wide range of applications.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Recall The theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a LP model.
CO2	Explain the theoretical workings of the graphical, simplex and analytical methods for makingeffective decision on variables so as to optimize the objective function.
CO3	Demonstrate the optimized material distribution schedule using transportation model tominimize total distribution cost.
CO4	Explain the theoretical workings of dynamic programming method to find shortest path forgiven network.
CO5	Appraise the need of Network Analysis, PERT and CPM.

Syllabus

MODULES	(NO. OF LECTURE HOURS)
Module 1 Linear Programming: Introduction, LP Formulations, Graphical method for solving LPs with 2 variables, Special Cases in Graphical Methods.	**8**
Module 2 Simplex Method, Big-M method, Two phase method, Revised simplex method, Duality in Linear programming.	**8**

Module 3 Dynamic Programming: Basic Concepts, Bellman's optimality principles, Dynamics programming approach in decision making problems, optimal subdivision problem.	**8**
Module 4 Transportation Problems, Basic Feasible Solution of a Transportation Problem, Unbalanced Transportation Problem, Degenerate Transportation Problem, Assignment Problems.	**8**
Module 5 Network Analysis: Basic components of Network, Rules for drawing Network diagram Time calculation in Networks. Critical Path Method and PROJECT Evaluation and Review Techniques. Algorithm and flow chart for CPM and PERT.	**8**

TEXT BOOKS:

1. Kanti Swarup, Gupta, P.K. and Manmohan, Operations Research, Sultan Chand.

REFERENCE BOOKS:

1. Hamdy A. Taha, Operations Research; Pearson, 10th Ed.
2. Operations Research Theory & Application, J.K. Sharma, Macmillan, 3rd Ed.

Gaps in the Syllabus (to meet Industry/Profession requirements)

Integer Programming and Non-Linear Progamming Problems to be covered in Advance Topic

POs met through Gaps in the Syllabus - 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Advanced Optimization Theory

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 4, 12

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	2	2	1	2	2	2	2	1	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD3
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN332**
Course Title	**: ADVANCED JAVA PROGRAMMING LAB**
Pre-requisite(s)	**: Java Programming Lab**
Co- requisite(s)	**: Advanced Java Programming**
Credits: 2 L:0 T:0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VI/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Implement GUI interfaces for user interaction.
B.	Implement database connectivity with frontend applications.
C.	Solve basic problems using JSP.
D.	Use existing classes and objects/group of objects for different applications.
E.	Implement various applications.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Implement different applications using Swing.
CO2	Write programs to connect the database to build frontend-backend based applications.
CO3	Implement solutions of different problems using JSP.
CO4	Use JavaBean for implementation.
CO5	Implement client-server framework and solve different problems.

Syllabus

List of Programs as Assignments:

1. Write an Applet which will play two sound notes in a sequence continuously use the play () methods available in the applet class and the methods in the Audio clip interface.
2. Create a Japplet using swing control, which will create a layout and handle necessary events.
3. Use JDBC connectivity and create Table, insert and update data.
4. Write a JSP program to calculate factorial of a number, while the input is taken from an HTML form.
5. Write a JSP program to generate Fibonacci series, while the starting values should be taken from an HTML form.
6. Write a JSP program to show system date and time.
7. Write a program in Java to implement a Client/Server application using RMI.
8. Write a program in Java to create a Cookie and set the expiry time of the same.
9. Write a program in Java to create Servlet to count the number of visitors to a web page.
10. Write a program in Java to create a form and validate a password using Servlet.
11. Develop a Java Bean to demonstrate the use of the same.
12. Write a program in Java to convert an image in RGB to a Grayscale image.
13. Develop Chat Server using Java.

TEXT BOOKS:

1. Gayatri Patel, Advanced JAVA Laboratory Manual, Osmora Incorporated, 2016.

REFERENCE BOOKS:

1. Herbert Schildt, Java - The Complete Reference, Ninth Edition, Oracle Press.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design:

1. Implementation of client-server-based applications with the support of database connectivity.

POs met through Topics beyond syllabus/Advanced topics/Design - PO2, PO3, PO4, PO11

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	2	1	1	1	1	1	2	1	1	2	2	1	1
CO2	2	1	2	2	1	1	1	1	1	1	2	1	1	1	1
CO3	1	2	2	2	1	1	1	1	2	1	2	1	2	1	1
CO4	2	1	2	2	1	1	1	1	2	1	2	1	2	1	1
CO5	2	2	2	2	1	1	1	1	1	1	2	1	2	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD4, CD5
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN334**
Course Title : **DATA ANALYTICS LAB**
Pre-requisite(s) :
Co- requisite(s) : **Data Analytics**
Credits: 2 L: 0 T: 0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VI/3**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know details of programming concepts (using Python, R etc.)
B.	Understand Applications, advantages and limitations of various data types.
C.	Real life use of data analytics.
D.	Projects on data analytics using any Language like Python, R etc.
E.	Use tool to develop applications.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Basic concepts of programming.
CO2	Classify features of programming and skills for various data analytic tool.
CO3	Apply the knowledge gained for their project work as well as to develop some statistical applications.
CO4	Apply various statistical techniques for data analysis and hypothesis testing.
CO5	Visualize data effectively using appropriate charts, graphs, and visualization libraries.

Syllabus

List of Programs as Assignments:
1. Data Exploration and Descriptive Statistics:
    a. Program on data reading and writing using csv file.
    b. Load a dataset of your choice and perform initial exploratory data analysis.
    c. Calculate descriptive statistics (mean, median, standard deviation) for a specific variable in the dataset.
    d. Visualize the distribution of a numerical variable using a histogram or box plot.
2. Data Cleaning and Preprocessing:
    a. Handle missing values in a dataset using appropriate techniques (e.g., imputation, deletion).
    b. Identify and handle outliers in a dataset using visualization and statistical methods.
    c. Perform data normalization or standardization on a numerical variable.
3. Hypothesis Testing:
    a. Formulate a null and alternative hypothesis for a given research question.
    b. Conduct a t-test to compare the means of two independent groups.
    c. Perform a chi-square test of independence to assess the relationship between two categorical variables.
4. Regression Analysis:

   a. Build a simple linear regression model to analyze the relationship between two variables.
   b. Interpret the coefficients and significance levels in a multiple linear regression model.
5. Hypothesis Testing with Categorical Variables:
   a. Conduct a chi-square test of independence to determine if there is a relationship between two categorical variables.
   b. Calculate the odds ratio and interpret its significance in logistic regression.
6. Model Evaluation and Selection:
   a. Split a dataset into training and testing sets and evaluate the performance of a predictive model.
   b. Compare different machine learning models (e.g., decision tree, random forest) and select the best performing one based on evaluation metrics.

TEXT BOOKS:

1. R for Everyone: Advanced Analytics and Graphics, Book by Jared P. Lander
2. "Exploratory Data Analysis" by John W. Tukey
3. "R Graphics Cookbook" by Winston Chang

REFERENCE BOOKS:

1. "Storytelling with Data" by Cole Nussbaumer Knaflic
2. "Data Visualization: A Practical Introduction" by Kieran Healy

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	1	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD8, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD3, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD3, CD4, CD6, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN338**
Course Title	**: DATA MINING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Introduction to Data Mining**
Credits:2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester /Level	**: VI/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Explain about the necessity of preprocessing and its procedure.
B.	Generate and evaluate Association patterns.
C.	Solve problems using various Classifiers.
D.	Learn the principles of Data mining techniques and various mining algorithms.
E.	Learn about traditional and modern data driven approach and problem-solving techniques for various datasets.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand Data Warehousing and Data Mining and its applications and challenges and create mini data warehouse.
CO2	Apply the association rules for mining applications.
CO3	Identify appropriate Classification techniques for various problems with high dimensional data.
CO4	Implement appropriate Clustering techniques for various problems with high dimensional data sets.
CO5	Implement various mining techniques on complex data objects.

Syllabus

List of Programs as Assignments:
1) Download and install WEKA. Build a Data Warehouse and Explore WEKA tool. Explore the available datasets in WEKA. Load various datasets and observe the following”
    i. List the attribute names and their types
    ii. No. of records in each dataset
    iii. Identify the class attribute(if any)
    iv. Plot Histogram
    v. Determine the no. of records for each class
    vi. Visualize the data in different dimensions.
2) Create your own EXCEL file. Convert the EXCEL file to .csv format and prepare it as .arff file.
3) Preprocess and classify Customer, Argiculture, Weather, Whole-sale Customers or the datasets of your own choice from https://archive.ics.uci.edu/ml/datasets.php
4) Demonstration of Association rule process on dataset using apriori algorithm.
5) Demonstrate performance of classification on various data sets.
6) Demonstrate performance of clustering on various data sets.
7) Demonstrate performance of Regression on various data sets.

8) Implement following algorithms for various datasets
   i. Apriori Algorithm.
   ii. K-means clustering.
9) Implement Bayesian Classification for various datasets
10) Implement Decision Tree for various datasets.

TEXT BOOKS:

1. Jiawei Han & Micheline Kamber - Data Mining Concepts & Techniques Publisher Harcout India. Private Limited.

REFERENCE BOOKS:

1. G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi
2. A. Berson& S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Implementing of real-world problems

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Teaching through research papers.

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	3	2	2	1	2	2	2	1	2	2	2
CO2	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN340**
Course Title	**: INTERNET OF THINGS LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Internet of Things**
Credits:2 L: 0 T:0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VI/3**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the basic concept and the IoT Paradigm.
B.	Know the state of art architecture for IoT applications.
C.	Learn the available protocols used for IoT.
D.	Design basic IoT Applications.
E.	Evaluate optimal IoT applications.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Interpret the impact and challenges posed by IoT networks leading to new architectural models. Identify the IoT Components and its capabilities.
CO2	Explain the architectural view of IoT under real world constraints.
CO3	Analyze the different Network and link layer protocols.
CO4	Evaluate and choose among the transport layer protocol.
CO5	Design an IoT application.

Syllabus

List of Programs as Assignments:

1. Study of Arduino Uno.
2. Study of Raspberry PI.
3. Start Raspberry Pi and try various Linux commands in command terminal window: ls, cd, touch, mv, rm, man, mkdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping etc.
4. Run some python programs on Pi like:
    a. Read your name and print Hello message with name
    b. Read two numbers and print their sum, difference, product, and division.
    c. Word and character count of a given string
    d. Area of a given shape (rectangle, triangle, and circle) reading shape and appropriate values from standard input.
5. Run some Python programs on Pi like:
    a. Print a name ‘n times. Where name and n are read from standard input, using for and while loops.
    b. Handel Divided by Zero Exception
    c. Print current time for 10 times with an interval of 10 seconds
    d. Read a file line by line and print the word count of each line
6. a) Light an LED through Python program

b) Get input from two switches and switch ON corresponding LEDs.
c) Flash an LED at a given on time and off time cycle, where two times are taken from a file.

7. a) Flash an LED based on cron output (act as an alarm)
   b) Switch on a Relay at a given time using cron, where the relays contact, terminals are connected to a load.
   c) Get the status of a bulb at a remote place (on the LAN) through Web.

TEXTBOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD).
3. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly.

REFERENCE BOOKS:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan.
2. Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers.
3. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	1	1	1	1	1	1	2	2
CO2	3	2	1	1	1	3	1	2	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	2	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	2	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

ANNEXURE A
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

SEMESTER VII/VIII

Course Code : **CN401**
Course Title : **DEEP LEARNING**
Pre-requisite(s) :
Co- requisite(s) : **Deep Learning Lab**
Credits: 4 L: 3 T:1 P:0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the concepts of mathematical modelling.
B.	Explore the application areas of Neural Networks.
C.	Explore the basic concepts of Feed forward Neural Networks.
D.	Understand the idea of Convolutional Neural Networks and Recurrent Neural Networks.
E.	Understand the basic component of Machine Learning.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Able to differentiate between machine learning and deep learning.
CO2	Identify problems suitable for application of deep learning.
CO3	Understand the working of FF Neural Networks and their modifications.
CO4	Apply Recurrent Neural Networks to solve problems.
CO5	Apply Recurrent Neural Networks to solve problems.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **From Logic to Cognitive Science:** The Beginnings of Artificial Neural Networks, The XOR Problem, From Cognitive Science to Deep Learning Neural Networks in the general AI Landscape.	**8**
Module 2 **Machine Learning Basics:** Elementary Classification Problem ,Evaluating Classification Results, A Simple Classifier: Naive Bayes, A Simple Neural Network: Logistic Regression, Introducing the MNIST Dataset, Learning Without Labels: K-Means, Learning Different Representations: PCA, Learning Language: The Bag of Words Representation.	**8**

Module 3 **Feedforward Neural Networks:** Basic Concepts and Terminology for Neural Networks, Representing Network Components with Vectors and Matrices, The Perceptron Rule, The Delta Rule, From the Logistic Neuron to Backpropagation. A Complete Feedforward Neural Network.	**8**
Module 4 **Convolutional Neural Networks:** A Third Visit to Logistic Regression, Feature Maps and Pooling. A Complete Convolutional Network, Using a Convolutional Network to Classify Text and Sequences of Unequal Length.	**8**
Module 5 **Recurrent Neural Networks:** The Three Settings of Learning with Recurrent Neural Networks, Adding Feedback Loops and Unfolding a Neural Network, Long Short-Term Memory. Using a Recurrent Neural Network for predicting words.	**8**

TEXT BOOKS:

1. Skansi S., Introduction to Deep Learning -From Logical Calculus to Artificial Intelligence, Springer International Publishing.

REFERENCE BOOKS:

1. Buduma N., Fundamentals of Deep Learning, O Reilly Media.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Application of neural network in decision making.
2. Application of deep learning in real life problems.

POs met through Gaps in the Syllabus: 4,5

Topics beyond syllabus/Advanced topics/Design

1. Design of Deep Learning based system to solve problems.
2. Combine Deep Learning with other domains to solve complex system.

POs met through Topics beyond syllabus/Advanced topics/Design: 4,6,10

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	1	1	3	2	2	2	2	2	2	2	3	3	3
CO2	2	3	2	3	3	3	2	2	2	2	2	2	3	3	3
CO3	3	3	3	3	3	2	2	2	2	2	2	2	3	3	3
CO4	3	3	3	3	3	2	3	2	2	2	2	2	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8
CD3	Seminars	CO3	CD1, CD8
CD4	Mini Projects/Projects	CO4	CD2, CD4
CD5	Laboratory Experiments/Teaching Aids	CO5	CD3, CD1
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN411**
Course Title : **DATA VISUALIZATION**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know the basics of data visualization.
B.	Introduce visual perception and core skills for visual analysis.
C.	Translate and present data and data correlations in a simple way.
D.	Have an understanding of various tools for creating data visualizations.
E.	Learn to wisely use various visualization structures such as tables, spatial data, time-varying data, tree and network.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Demonstrate understanding of Data Visualization and key Terms.
CO2	Demonstrate skills on creating visual representation of Data.
CO3	Apply visualization techniques for various data analysis tasks.
CO4	Demonstrate understanding of Visualization classification and its techniques.
CO5	Demonstrate skills in creating different types of Representation.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Introduction to data visualization, History of data visualization, importance of data visualization in data science, Principles of data visualization, Visual mapping and Elements of data visualization. Common tools and techniques for creating data visualizations.	**8**
Module 2 Introduction of various charts and graphs, Design principles for charts and graphs, The do’s and don’ts of charts and graphs making. The process of creating visualizations and selecting the appropriate visual display.	**8**
Module 3 Visualization as exploration, visualizing categorical data, Visualizing time series data, Visualizing Geospatial data, Visualizing multiple variables.	**8**

Module 4 Introduction of Dashboard design, various types of Dashboards, Interactive visualizations, Story Telling through Data.	**8**
Module 5 Visualization of groups, trees, graphs, clusters, networks. Data science use cases for data visualization.	**8**

TEXT BOOKS:

1. Wong, D., The Wall Street Journal guide to information graphics: The dos and don'ts of presenting data, facts and figures. New York: W.W. Norton & Company.
2. Yau, N., Data Points: Visualization that means something. Indianapolis: O'Reilly.
3. Kieran Healy, Data Visualization: A Practical Introduction.

REFERENCE BOOKS:

1. Few, S., Information dashboard design: The effective visual communication of data. Sebastopol: O'Reilly.
2. Ware, C & Kaufman, M., Visual thinking for design. Burlington: Morgan Kaufmann Publishers.
3. Ward, Grinstein Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1	1	1	3	1	1	2	2	3	3	1	2	1
CO2	3	3	3	2	2	1	1	1	2	1	3	3	3	2	3
CO3	3	3	3	2	3	1	1	1	2	1	2	2	2	2	2
CO4	3	3	3	2	3	1	1	1	3	3	3	3	2	2	2
CO5	3	3	3	2	2	1	1	2	2	1	2	2	2	2	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD5, CD6, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD4, CD5
CD3	Seminars	CO3	CD1, CD2, CD3, CD4, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3, CD4, CD6
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD,6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN402**
Course Title	**: DEEP LEARNING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Deep Learning**
Credits: 2 L: 0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Explore Tensor Flow, Keras.
B.	Implement back propagation networks.
C.	Implement of Convolutions networks.
D.	Implement feed forward neural networks.
E.	Implementation of Text Classification, Word Embeddings and Language Models.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand MLP with Keras.
CO2	Implement Backpropagation in Neural Networks.
CO3	Design Convolutional Neural Networks for Image Classification.
CO4	Analyze feed forward networks.
CO5	Implement & analyze Deep Learning for Image Segmentation.

Syllabus

List of Programs as Assignments:

Lab Assignment No: 1

Objective: Intro to Deep Learning Neural Networks and Backpropagation

Q.1 Intro to MLP with Keras

Lab Assignment No: 2

Objective: Neural Networks and Backpropagation

Q.1 Backpropagation in Neural Networks

Lab Assignment No: 3

Objective: Convolutional Neural Networks for Image Classification

Q.1 Design of Convolutions Neural network for image classification

Lab Assignment No: 4

Objective: Deep Learning for Object Detection

Q.1 Design of Fully Convolutional Neural Networks for object detection

Lab Assignment No: 5

Objective: Deep Learning for Image Segmentation

Q.1 Design of Fully Convolutional Neural Networks for Image Segmentation

TEXT BOOKS:

1. Deep Learning with TensorFlow 2 and Keras: Regression, ConvNets, GANs, RNNs, NLP, and more with TensorFlow 2 and the Keras API, by Antonio Gulli, Amita Kapoor, Sujit Pal.

REFERENCE BOOKS:

1. Learning Tensor Flow: A Guide to Building Deep Learning Systems, Tom Hope, Yehezkel S. Resheff

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD9
CD2	Tutorials/Assignments	CO2	CD1, CD5, CD9
CD3	Seminars	CO3	CD1, CD5, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD5, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN412**
Course Title : **DATA VISUALIZATION LAB**
Pre-requisite(s) :
Co- requisite(s) : **Data Visualization**
Credits:2 L: 0 T: 0 P: 4
Class schedule per week :**04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Interpret data plots and understand core data visualization concepts such as correlation, linear relationships, and log scales.
B.	Explore the relationship between two continuous variables using scatter plots and line plots.
C.	Translate and present data and data correlations in a simple way.
D.	Design interactive dashboard using tableau.
E.	Explore all the aspects of Tableau and R for solving data visualization.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Design effective data visualizations.
CO2	Find and select appropriate data that can be used in order to create a visualization.
CO3	Apply visualization techniques for various data analysis tasks.
CO4	Create ad-hoc reports, data visualizations, and dashboards using Tableau.
CO5	Apply visualization techniques for various real time use cases.

SYLLABUS

List of Programs as Assignments:

1. Exploring Data Visualization tools: Tableau, Power BI, R-Programming Language.
2. Hands on with Tableau
3. Creating charts and graphs with Tableau and R.
4. Visualization of Categorical Data using Tableau and R.
5. Geospatial Data visualization using Tableau and R.
6. Time-Series Data Visualization using Tableau and R.
7. Creating word cloud using Tableau and R.
8. Design interactive dashboard using Tableau.
9. Telling story with data by using Tableau.
10. Solve a case study which must cover all aspects of visualization.

TEXT BOOKS:

1. Visual Analytics with Tableau by Alexander Loth, Nate Vogel, Sophie Sparkes, Wiley Publication.
2. R for data science: Import, Tidy, Transform, Visualize, And Model Data by Hadley Wickham, Garrett Grolemund.

REFERENCE BOOKS:

1. Visualization Analysis & Design by Tamara Munzner.
2. Interactive Data Visualization for the Web by Scott Murray.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	1	2	2	3	3	1	3	2	2
CO2	3	3	3	2	1	1	1	2	2	3	3	1	3	2	2
CO3	3	3	3	3	1	1	1	2	2	3	3	1	3	2	2
CO4	3	3	3	3	2	2	1	1	2	3	3	1	3	1	2
CO5	3	3	3	3	2	2	1	1	2	3	3	1	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1 CD4, CD5
CD2	Tutorials/Assignments	CO2	CD2, CD4, CD5
CD3	Seminars	CO3	CD4, CD5
CD4	Mini Projects/Projects	CO4	CD4, CD5, CD6, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD4, CD5, CD6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN403**
Course Title : **DIGITAL GAMING**
Pre-requisite(s) :
Co- requisite(s) : **Digital Gaming Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the basic concepts of Digital Games and Interactive Multimedia.
B.	Define the components of a game and design a concept for a Game in game design document.
C.	Identify various stages of Game Production process.
D.	Illustrate the interactive story of a game.
E.	Analyse the games through the perspective of a game designer.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Analyse the Digital Games and other mediums of Interactive Storytelling.
CO2	Describe Game Development Process and its various stages.
CO3	Design board games and documents for digital games.
CO4	Create story and content of a game.
CO5	Critically analyse the game play of the games and will be introduced to Game Engine software.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1: **Understanding Games:** What is a Game, History, Game vs Books and Movies, Digital Games vs Traditional Games, Elements of Game, Game Genre.	**10**
Module 2 **Game Development Process:** Overview of Game Development, Game Design, Pre-production, Production, Game Art and Animation, Game User Interface, Game Audio, Quality Assurance (QA) and Testing, Game Publishing and Distribution, Project Management, Ethical Considerations (Intellectual Property, Rating System etc.)	**10**
Module 3 **Game Design Documentation:** Game Idea Generation, What is Game Design Document, Principles of Game Design, Sample Game Design Documents, Game Design Document Template, Board Game Design	**5**

Module 4 **Game Narrative:** Basics, Non-Linear Game Narrative / Interactive Storytelling, Character Development, Localization, Games and Culture	**7**
Module 5 **Game Appreciation and Analysis:** Game Appreciation: Game Play sessions and Discussions, Game Analysis: Tetris and Any Current Poplar Game, Serious Games: Analyze serious games	**8**

TEXT BOOKS:

1. Monograph of Story Appreciation for Gaming, Dept. of Animation and Multimedia, BIT Mesra Ranchi.
2. Monograph on Fundamentals of Game Technology, Dept. of Animation and Multimedia, BIT Mesra Ranchi.
3. Game Design for Teens by Les Pardew, Premier Press.

REFERENCE BOOKS:

1. Andrew Rollings and Ernest Adams on Game Design by A Rollings E Adams, New Riders Publisher.
2. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, CRC Press.
3. David Nixon, Unreal Game Engine for Beginners.
4. Chris Solarski, Interactive Stories and Video Game Art: A Storytelling Framework for Game Design, Taylor and Francis Group.
5. Simon Egenfeldt-Nielsen et al, Understanding Video Games: The Essential Introduction, Routledge, Taylor and Francis, New York.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	1	2	2	1	1	2	3	3	3	2	3	3	3
CO2	3	2	3	1	1	1	1	2	2	2	2	3	2	2	2
CO3	2	1	1	2	1	2	2	2	3	3	3	3	3	3	2
CO4	2	1	3	2	1	1	1	1	2	2	2	2	2	2	2
CO5	3	3	1	2	3	2	2	2	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD4, CD5, CD9
CD2	Tutorials/Assignments	CO2	CD1, CD6, CD8,
CD3	Seminars	CO3	CD1, CD4, CD5, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD6, CD8,
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD4, CD5, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	: **CN415**
Course Title	**: ADVANCED PYTHON PROGRAMMING**
Pre-requisite(s)	**: Python Programming**
Co- requisite(s)	**: Advanced Python Programming Lab**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII /4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand regular expressions in Python, Implementing data structures in python, Using various time functions.
B.	Understand the concepts of threads in Python.
C.	Create GUI using Python.
D.	Understand Networking through Python.
E.	Use Databases through Python, analyzing and visualizing data using Python.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Interpret regular expressions and various data structures in Python.
CO2	Implement the concepts of threads for developing efficient programs.
CO3	Design GUI programs.
CO4	Identify the commonly used operations involving networking.
CO5	Apply knowledge of database programming and data analysis in Python.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module I Abstract classes and Interface in Python. Regular Expressions in Python: Regular expressions, sequence characters, quantifiers, and special characters in regular expressions, using regular expressions on files, retrieving information from a HTML file. Date and Time in Python: Date and Time Now, Combining and formatting date and time, finding duration, comparing two dates, sorting dates, working with calendar Module. Data structures in Python: Linked list, stacks, and queues.	**8**
Module II Threads: Multitasking, Process and threads, concurrent programming and GIL, Uses of thread, creating threads, thread class methods, thread synchronization, locks, semaphore, deadlock of threads, thread communication using notify () and wait () methods, thread communication using queue, Daemon threads.	**8**

Module III GUI in Python: The Root Window, Fonts, and colors, working with containers, canvas, frame, widgets: Button widgets, arranging widgets in the frame, Label widget, message widget, text widget, scrollbar widgets, check button widget, radio button widget, entry widget, spin box widget, list box widget, menu widget, creating tables.	**8**
Module IV Network programming in Python: Sockets, knowing IP Address, URL, reading the source code of a webpage, downloading webpage from internet through python, A TCP/IP Server, TCP/IP client, File server, File client, two-way communication between server and client, sending a simple mail.	**8**
Module V Database programming using Python: Advantage of DBMS over Files, Using MySQL from Python, Creating and manipulating tables through Python. Data Analysis using Python: Series, Data Frame, creating data frames, operations on data frames. Data visualization: Bar graph, Histogram, pie chart, line graph. NumPy Library.	**8**

TEXT BOOKS:

1. Core Python Programming by Dr. R Nageswara Rao, Dreamtech Press India.
2. Python: The Complete Reference by Martin C. Brown, McGraw Hill Education.

REFERENCE BOOKS:

1. Programming Python: Powerful Object-Oriented Programming, Mark Lutz O'reilly.
2. Think Python, by Allen B. Downey, O'reilly.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

1. Image processing with Python

POs met through Topics beyond syllabus/Advanced topics/Design - PO3, PO5

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO2	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO3	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO4	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO5	3	3	3	3	3	2	2	2	2	3	2	2	3	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4, CD5
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD3, CD4, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD3, CD4, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3, CD4, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD4, CD5, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN404**
Course Title : **DIGITAL GAMING LAB**
Pre-requisite(s) :
Co- requisite(s) : **Digital Gaming**
Credits: 2 L: 0 T: 0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Familiarize students with the Unreal Engine interface, tools, and features, providing a foundation for working with the engine.
B.	Understand the fundamental concepts of game development, including game design principles, mechanics, and gameplay elements.
C.	Explore how to build 3D game environments using Unreal Engine, including level design, terrain creation, lighting, and asset placement.
D.	Implement the core game mechanics, such as player movement, physics, collision detection, and interactive elements.
E.	Understand Blueprint scripting, Unreal Engine's visual scripting system, enabling them to create gameplay logic, AI behaviors, and interactions.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Design Game Levels using Unreal Game Engine.
CO2	Explore the potential of Game and Interactive Application Development in upcoming fields like Augmented Reality, Virtual Reality and Mixed Reality.
CO3	Understand the process of testing, debugging, and refining their games to improve gameplay experience and address issues.
CO4	Understand the project management methodologies specific to game development / Multimedia Project.
CO5	Package and deploy their games for various platforms, such as PC, consoles, or mobile devices, and create a final showcase of their work.

Syllabus

The following exercise are designed for Unreal Game Engine but can be done in any current prevalent Game Engines:

1. Installing the Game Engine and Understanding the interface of the game engine (Unreal Editor) software and Demo of sample game
2. Creating, Opening and Saving the Game Levels
3. Playing a Game Level
4. Understanding Actors and using them > Static Mesh Actor & Material
5. Understanding Actors > Light & Geometry Brushes
6. Viewport Navigation in 3D space: mouse navigation, WASD navigation, Focusing, Maya Navigation, Camera Speed

7. Level Editor Overview: What is the difference between the Unreal Engine and the Unreal Editor. The different parts of the Level Editor - Viewport, Toolbar, Content Browser, Bottom Toolbar, Outliner, and Details Panel. How to customize the interface.
8. Viewport II – Moving, Rotating, and Scaling: How to use the translation, rotation, and scaling widgets. How to select multiple Actors and move them all at once. How to copy Actors. How to change the pivot point of an Actor. What is the difference between world space vs local space.
9. Viewport – Snapping: How to use snapping to perfectly align your Actors with one another within your Level. What is the difference between Surface Snapping, Grid Snapping, Rotation Snapping, Scale Snapping, and Vertex Snapping. The "Rotate to Surface Normal" and "Surface Offset" settings. What are snap sizes.
10. Viewport IV – Different Ways To View Your Level: What is Immersive Mode. What is the difference between the View Modes - Lit, Unlit, and Wireframe. What is the difference between a perspective view and an orthographic view. The Show Flags setting, Game View, and piloting Actors within the Viewport. The Viewport Options menu including Realtime, Show FPS, Show Stats, Show Toolbar, Field Of View, Far View Plane, Screen Percentage, and Bookmarks.
11. Content Browser I - Overview & Finding Content: The Sources Panel, Asset Window, Collections Panel, searching the Content Browser, and breadcrumbs. The Content Drawer, Dock in Layout button and search filters. What is the difference between static collections vs dynamic collections.
12. The Add New, Import, and Save All buttons of the Content Browser. How to use the "Add Feature or Content Pack" feature. How to migrate assets in Unreal Engine.
13. Actors > Atmosphere and Clouds, Player Start, Components, Volumes
14. Exercise: Creating Material
15. Exercise: Creating the Sky
16. Exercise: Creating the Playing Area: Construct the playing area for our game, using Brushes, Meshes, and Materials.
17. Exercise: Add the internal structures for our Level, including walls, platforms, and houses.
18. Introduction to Blueprints
19. Exercise: Use Blueprints to create our first custom Actor - a platform that will continually move up and down.
20. Exercise: Use Blueprint to create the enemies
21. Exercise: use Blueprint to create the rotating Door
22. Exercise: Create Destructible Mesh
23. Exercise: Create a Terrain
24. Exercise: Create a Playable Character
25. Collisions: Exercise: How to use collision volumes such as a Box Collision, Capsule Collision, or Sphere Collision.
26. Emitters: Exploring various types of emitters
27. Exercise: Creating Emitters
28. Exercise: Adding audio in the game
29. Exercise: User Interface: Creating HUD, Damage Tint and Collect Item Tint, Restrict Door Opening and Creating a Pause Menu, Game Over and Win Screen Menu etc.
30. Exercise: Packaging the Game for various platforms

TEXT BOOKS:

1. “Unreal Engine 4 for Beginners" by David Nixon

REFERENCE BOOKS:

1. "Unreal Engine 4 Game Development in 24 Hours" by Aram Cookson and Ryan Dowling Soka
2. "Unreal Engine 4 Game Development Essentials" by Satheesh PV
3. "Learning Unreal Engine Game Development" by Joanna Lee and Richard A. Hawley
4. "Mastering Unreal Technology: The Art of Level Design" by Jason Busby and Zak Parrish

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Exposure to other game engine such as Unity.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	3	3	3	2	2	2	3	2	3	3	3	3	2
CO2	2	2	1	2	3	1	1	2	3	2	3	3	3	3	2
CO3	3	3	1	3	2	1	1	2	3	2	3	3	3	3	2
CO4	3	2	1	2	2	1	1	2	3	3	3	3	3	3	2
CO5	2	2	3	2	3	2	2	2	3	2	3	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD4, CD5, CD8, CD9
CD2	Tutorials/Assignments	CO2	CD5, CD6,
CD3	Seminars	CO3	CD5, CD6,
CD4	Mini Projects/Projects	CO4	CD5, CD6,
CD5	Laboratory Experiments/Teaching Aids	CO5	CD4, CD5, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN416**
Course Title : **ADVANCED PYTHON PROGRAMMING LAB**
Pre-requisite(s) : **Python Programming**
Co- requisite(s) : **Advanced Python Programming**
Credits:2 L:0 T:0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Use regular expressions in Python, implementing data structures in python, using various time functions.
B.	Implement threads in Python.
C.	Create GUI programs in Python.
D.	Networking programming through Python.
E.	Create and manipulate databases in MySQL through Python. Using NumPy and Pandas to analyze and visualize data.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Implement various data structures using Python.
CO2	Implement the concepts of threads in a program.
CO3	Create GUI programs.
CO4	Implement networking through Python.
CO5	Store, retrieve, manipulate using MySQL in Python. Analyzing and visualizing data.

Syllabus

List of Programs as Assignments:
1. Implement stack data structure.
2. Implement Queue Data structure.
3. Implement Linked list.
4. Write Python program to find the day of the year and the week day name.
5. Write Python program to accept a date from the keyboard and display the day of the week.
6. Write Python program to find future date and time from an existing date & time.
7. Write Python program to generate random numbers in a range with some time delay between each number.
8. A program to find the currently running thread in a Python program.
9. Write Python program to pass arguments to a function and execute it using a thread.
10. Write Python program to create a thread by making our class as sub class to thread class.
11. Write Python program to create a thread that accesses the instance variables of a class.
12. Write Python program to create a thread that acts on the object of a class that is not derived from the thread class.
13. Write Python program to show single tasking using a thread.
14. Write Python program to perform two tasks using two threads simultaneously.
15. Write Python program where threads are acting on the same method to allot a berth for the passenger.

16. Write Python program achieving thread synchronization using locks.
17. Write Python program to demonstrate deadlock of threads due to locks on objects.
18. Write Python program where thread communication is done through notify() and wait().
19. Write Python program where thread communication is done using queue.
20. Write Python program to create a daemon thread.
21. Write Python program to draw various shapes in canvas.
22. Write Python program to display images in the canvas.
23. Write Python program to display drawing in the canvas.
24. Write Python program to create a text widget with a vertical scroll br attached to it.
25. Write Python program to create horizontal scroll bar and attach it to a text widget to view the text from left to right.
26. Write Python program to create four check buttons and know which options are selected by the user.
27. Write Python program to create two radio buttons and know which option is selected by the user.
28. Write Python program to create Entry widgets for entering user name and password and display the entered text.
29. Write Python program to create two spin boxes and retrieved the values displayed in the spin boxes when the user clicks on a push button.
30. Write Python program to create a list box with course names and display which courses are selected by user.
31. A GUI program to display a menu and to open a file and save it through the file dialog box.
32. Write Python program to create a table with four rows and three columns.
33. Write Python program to find the IP address of a website.
34. A python program to retrieve different parts of the URL and display them.
35. Write Python program to read source code of a web page.
36. Write Python program to download a web page from internet and save it into our computer.
37. Write Python program to download an image from the internet.
38. Write Python program to create a TCP/IP server program that sends messages to a client.
39. Write Python program to create a TCP/IP client program that receives messages from the server.
40. Write Python program to create a basic chat server program in Python.
41. Write Python program to create a basic chat client program in Python.
42. Write Python program to send email to any mail address.
43. Write Python program to retrieve and display all rows of emp table in mysql.
44. Write Python program to insert n rows into a table in Mysql.
45. Write Python program to create student table (name,roll,coursename and age) in mysql.
46. Write Python program to retrieve student’s information by entering his roll number.
47. Create data frame using csv file. Retrieve the data through data frame.
48. Write Python program to display students roll number on x-axis and total marks on y-axis in the form of a bar graph.
49. Write Python program to create line graph to show year wise profit of a company.
50. Write Python program to display a pie chart showing the percentage of employees in each department of a company.

TEXT BOOKS

1. Core Python Programming by Dr. R Nageswara Rao, Dreamtech Press India.
2. Python: The Complete Reference by Martin C. Brown, McGraw Hill Education.

REFERENCE BOOKS

1. Programming Python: Powerful Object-Oriented Programming by Mark Lutz.
2. Think Python by Allen B. Downey.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Seaborn libraries and web scrapping module Beautiful Soup

POs met through Gaps in the Syllabus - PO3, PO5

Topics beyond syllabus/Advanced topics/Design

1. Image processing with Python

POs met through Topics beyond syllabus/Advanced topics/Design - PO3, PO5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO2	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO3	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO4	3	3	3	2	3	2	2	2	2	3	2	2	3	2	2
CO5	3	3	3	3	3	2	2	2	2	3	2	2	3	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD4, CD5
CD2	Tutorials/Assignments	CO2	CD4, CD5
CD3	Seminars	CO3	CD4, CD5
CD4	Mini Projects/Projects	CO4	CD4, CD5

CD5	Laboratory Experiments/Teaching Aids	CO5	CD4, CD5, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN407**
Course Title : **RESEARCH METHODOLOGY**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII /4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Study and understand the research issues & challenges, research goals, scientific methods
B.	Understand the concepts of Research Design in real world studies.
C.	Gain skills in conducting data gathering activities for research studies through Various tools
D.	Get a clear concept of sampling methods in tune with the primary data requirements of any given study.
E.	Reviewing Literature and Research Papers; Writing Research Papers, Thesis, Reports and Project Proposals Plagiarism and Copyrights.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Identify the need for and importance of Research in context of different situations and environments.
CO2	The basic concepts of research and its methodologies, identify appropriate research topics, select, and define appropriate research problem and parameters.
CO3	Prepare questionnaires, interview schedules and implement them for primary data collection in context of any given study.
CO4	Decide and implement the most appropriate probability/non-probability sampling techniques for a given study.
CO5	Organize and conduct research in a more appropriate manner, writing research report and thesis.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module I **Research An Introductory Approach: Meaning**, Characteristics and Importance, Types of Research, The Research process (Overview and Steps), The Research problem: Definition, need, importance, steps and related dimensions.	**8**
Module II **Research Design:** Meaning, Characteristics of a Good research Design, Types of Research Designs, Components of a research Design.	**8**

Module III **Sources of Collection of Data:** –Primary Data (Method questionnaire development), Secondary Data (Sources and Precautions in the Use of Secondary Data) **Sampling, Methods of Collecting Data: Meaning**, Steps and Types (simple random, stratified random, systematic and cluster samplings), Survey and Observation Methods.	**8**
Module IV **Computer Science Research Context**: Nature of Computer Science (CS) Research, Scientific Methods in Computer science, Types of Research in CS, Research Methods in Computer Science, Research Paradigms in CS, Challenges for CS Research.	**8**
Module V **Research Skills**: Reviewing Literature and Research Papers; Writing Research Papers, Thesis, Reports and Project Proposals; Formatting, Appendices, Citation Formats and Style; General Conventions, Issues, Plagiarism and Copyrights.	**8**

TEXT BOOKS:

1. Ghosh, B. N. Scientific Method and Social Research (Sterling: New Delhi)
2. Kothari, C.R. Research Methodology Methods and Techniques (NewAge: New Delhi)
3. Gupta, Santosh Research Methodology and Statistical Techniques (Deep and Deep Publications: New Delhi)

REFERENCE BOOKS

1. Research Methodology: a step-by -step guide for beginners, Kumar, Pearson Education.
2. Practical Research Methods, Dawson, C., UBSPD Pvt Ltd.
3. Montgomary, Douglas C. & Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India).
4. Kothari C.K. (2004) 2/e, Research Methodology — Methods and Techniques (New Age International, New Delhi).
5. Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi).
6. Krishnaswami, O.R. Methodology of Research in Social Science (Himalaya Publishing House: Mumbai.)

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (Pos)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN405**
Course Title : **SOFT COMPUTING**
Pre-requisite(s) :
Co- requisite(s) : **Soft Computing Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII /4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the concept of fuzzy logic and controllers.
B.	Understand the various architectures of ANN and its learning methods.
C.	Learn about basic concepts of genetic algorithm and its operators.
D.	Understand the Artificial Neural Networks.
E.	Understand the Genetic Algorithms.

Course Outcomes
After the completion of this course, students will be able to:

CO1.	Solve numerical on Fuzzy sets and Fuzzy Reasoning.
CO2.	Develop Fuzzy Inference System (FIS).
CO3.	Solve problems on Genetic Algorithms.
CO4.	Explain concepts of neural networks.
CO5.	Develop neural networks models for various applications.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module – I **Fuzzy Set Theory:** Basic Definition and Terminology, Set Theoretic Operations, Fuzzy types and levels, MF Formulation and Parameterization, Fuzzy Union, Intersection and Complement, Fuzzy Number, Fuzzy measure.	**8**
Module – II **Fuzzy Logic:** Fuzzy Rules and Fuzzy Reasoning: Extension Principles and Fuzzy Relations, Fuzzy IF THEN Rules, Defuzzification, Fuzzy Reasoning. Fuzzy Inference System: Introduction, Mamdani Fuzzy Models, Other Variants, Takagi-Sugeno Fuzzy Models.	**8**
Module – III **Fundamentals of Genetic Algorithms:** Basic Concepts, Creation of Offsprings, Encoding, Fitness Functions, Reproduction, Genetic Modelling: Inheritance Operators, Cross over, Inversion and detection, Mutation operator, Bitwise operators.	**8**
Module – IV **Introduction to Artificial Neural Networks:** What is a Neural Network? Human Brain, Models of Neuron, Neural Network viewed as Directed Graphs, Feedback, Network	**8**

Architecture, Learning processes (Hebbian, Competitive, Boltzman, Supervised, Unsupervised), Perceptrons, Adaline, Madaline.	
Module – V Back Propagation Algorithm, Effect Of Tuning Parameters Of The Back Propagation Neural Network, Selection Of Various Parameters In BPN, Associative Memory and Adaptive Resonance Theory, Autocorrelators, Hetro correlators.	**8**

TEXT BOOKS

1. Jang J.S.R., Sun C.T. and Mizutani E., "Neuro-Fuzzy and Soft Computing" PHI/Pearson Education, New Delhi, 2004.
2. Rajasekaran S. &Vijayalakshmi, G.A. Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications", PHI, New Delhi, 2003.
3. Ross T. J., "Fuzzy Logic with Engineering Applications", TMH, New York, 1997.
4. Haykins Simon, "Neural Networks:A Comprehensive Foundation", Pearson Education,2002.

REFERENCE BOOKS

1. Ray K.S., "Soft Computing and Its application", Vol 1, Apple Academic Press.2015.
2. Lee K.H., "First Course on Fuzzy Theory and App.", Adv in Soft Computing Spinger.2005.
3. Zimmermann H.Z., "Fuzzy Set Theory and its App", 4thEdition, Spinger Science,2001.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Application of soft computing to develop and design the adaptive controllers.
2. Application of fuzzy inference system for prediction and modelling to complex problems.

POs met through Gaps in the Syllabus - 3, 5

Topics beyond syllabus/Advanced topics/Design

1. Concepts and features of hard computing and soft computing.
2. NN- controller for an intelligent and autonomous robot.
3. Merits and Demerits of soft computing tools.

POs met through Topics beyond syllabus/Advanced topics/Design - 2, 3, 5

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN409**
Course Title	**: NATURAL LANGUAGE PROCESSING**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the N-gram language model and Neural language model.
B.	Understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
C.	Understand basic knowledge on various morphological, syntactic, and semantic NLP tasks.
D.	Understand various parsing algorithms of language.
E.	Learn to extract features from text. Understand embedding algorithms.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.
CO2	Understanding of the relationship between NLP and statistics & machine learning.
CO3	Discover various linguistic and statistical features relevant to the basic NLP tasks such as spelling detection and correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis.
CO4	Develop systems for various NLP problems with moderate complexity.
CO5	Evaluate NLP systems, identify shortcomings and suggest solutions for these short coming.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 Introduction to NLP – introduction and applications, NLP phases, Difficulty of NLP including ambiguity; Spelling error and Noisy Channel Model.	**8**
Module 2 Language Modelling: Unigram Language Model, Bigram, Trigram, N-gram, basic Neural network for NLP, Neural Language Modelling with N-gram, smoothing techniques. Evaluating language models; Perplexity vs Entropy.	**8**

Module 3 Parts-of-speech Tagging: basic concepts; English word classes; Tag-set; Early approaches: Rule based and TBL; POS tagging using HMM. HMM tagging as decoding. Tokenization and Sentence splitting.	**8**
Module 4 Parsing Basic concepts: top down and bottom-up parsing, treebank; Syntactic parsing: CKY parsing and its application. Context Free Grammar. Statistical Parsing basics: Probabilistic Context Free Grammar (PCFG); Probabilistic CKY Parsing of PCFGs.	**8**
Module 5 Semantics Vector Semantics; Words and Vector; Measuring Similarity; Semantics with dense vectors: SVD and Latent Semantic Analysis; Embeddings from prediction: Skip-gram and CBOW.	**8**

TEXT BOOKS:

1. Jurafsky Dan and Martin James H. "Speech and Language Processing", Pearson Education.
2. Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition".

REFERENCE BOOKS:

1. Goldberg Yoav "A Primer on Neural Network Models for Natural Language Processing.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Visualize POS and NER with Spacy

POs met through Gaps in the Syllabus - PO1, PO2 &PO3

Topics beyond syllabus/Advanced topics/Design

1. Deep learning models in NLP

POs met through Topics beyond syllabus/Advanced topics/Design - PO2 & PO3

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	1	1	2	1	2	1	3	2	2	2	2	2
CO2	3	3	2	2	3	3	2	2	2	2	2	2	3	2	2
CO3	3	3	3	3	3	3	2	2	2	3	2	2	3	3	2
CO4	2	3	3	3	3	3	3	3	2	2	3	3	3	2	2
CO5	2	3	2	2	3	2	2	2	1	2	2	2	2	2	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD3	Seminars	CO3	CD1, CD2, CD3, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN413**
Course Title : **ADVANCED DATA ANALYTICS**
Pre-requisite(s) : **Data Analytics**
Co- requisite(s) : **Advanced Data Analytics Lab**
Credits:3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know the data and its characteristics.
B.	Understand data relationship, advanced data analysis: classification clustering.
C.	Understand association rules extraction from the transaction data sets using various methods.
D.	Identify Time series data analysis for forecasting.
E.	Learn text data analysis.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Get the insight about the data.
CO2	Establish the Data relationship and able to analyze the data in more advance way.
CO3	Extract associative patterns from the transactional data.
CO4	Forecasting about the future using the time series data analysis.
CO5	Perform text data analysis.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module I **Data analytics overview:** Type of data analytics, Descriptive, Diagnostic, Predictive and Prescriptive Analytics. Various graphical methods of Data visualization. Various Probabilistic data distributions. Data normalization Multidimensional Data Examples and problems of high Dimensional data. Dimension reduction techniques: Principal component analysis.	**8**
Module II **Data relationship:** Correlation of data, Simple and multiple regression analysis, Chi square testing, One way and two ways ANOVA analysis. **Pattern Classification using:** Bayesian classifiers, logistic regression. Data **Clustering:** Using KMeans and KMedoids method, Using Hierarchical methods	**8**
Module III	**8**

Basic concept of Association rules extractions: Market Basket Analysis example. Frequent Itemsets, Closed Itemsets, and Association Rules. Frequent Itemset Mining Methods: Apriori Algorithm: Finding Frequent Itemsets by Confined Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, Pattern-Growth Approach for Mining Frequent Itemsets, Mining Frequent Itemsets Using Vertical Data Format, Mining Closed and Max Patterns.	
Module IV **Time Series Data Analysis:** Introduction, Method of Forecasting, Components of time series: Secular Trend, Seasonal Variations, Cyclical Variations, Irregular variations. Methods: Straight line trend, Non-linear trend, Measuring trends by logarithm: Exponential trend. Measurement of Seasonal variations, Measurement of cyclical and Irregular variations. Auto regression method of forecasting.	**8**
Module V **Text data analysis:** Processing and understanding text-Text tokenization and normalization, Text classification: Multinomial naïve bayes and SVM method, Text Similarity and clustering: Analyzing term and document similarities, document clustering. Semantic and Sentiment Analysis.	**8**

TEXT BOOKS:

1. Han J and Kamber M, "Data Mining: Concepts and techniques", Morgan Kaufmann Publishers. 2nd and 3rd Edition.
2. Gupta and Gupta, "Business Statistics", Sultan Chand and Sons, 2014.

REFERENCE BOOKS:

1. Sayan Mukhopadhyay, "Advanced Data Analytics Using Python", Apress, 2018
2. Maheshwari Anil, "Data Analytics", Mc Graw hill publication, 2017.
3. Dipanjan Sarkar, "Text Analytics with Python", Apress, 2016

Gaps in the Syllabus (to meet Industry/Profession requirements)

Working on real life data collected from the industries and institutions.

POs met through Gaps in the Syllabus - 6, 9, 11 and 12

Topics beyond syllabus/Advanced topics/Design

1. Some other classification and clustering techniques
2. Web data scraping and its analysis

POs met through Topics beyond syllabus/Advanced topics/Design - 5, 8, 11, and 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment
1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	2	2	2	1	1	1	1	1	2	3
CO2	3	3	2	2	1	3	1	1	2	1	1	2	3	2	3
CO3	3	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	3	3	3	3	3	1	3	1	3	1	3	3	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD4 CD8 CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4 CD8 CD5, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN421**
Course Title : **REINFORCEMENT LEARNING**
Pre-requisite(s) : **Introduction to Machine Learning, Deep Learning**
Co- requisite(s) : **Reinforcement Learning Lab**
Credits: 3 L: 3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
B.	Given an application problem (e.g. from computer vision, robotics, etc), decide if it should be formulated as a RL problem; if yes be able to define it formally (in terms of the state space, action space, dynamics and reward model), state what algorithm (from class) is best suited for addressing it and justify your answer
C.	Describe (list and define) multiple criteria for analyzing RL algorithms and evaluate algorithms on these metrics: e.g. regret, sample complexity, computational complexity, empirical performance, convergence, etc
D.	Describe the exploration vs exploitation challenge and compare and contrast at least two approaches for addressing this challenge (in terms of performance, scalability, complexity of implementation, and theoretical guarantees)
E.	Be able to apply these concepts to solve real world problems.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Learn how to define RL tasks and the core principals behind the RL, including Markov decision processes, policies, value functions, deriving Bellman equations
CO2	Understand and work with tabular methods to solve classical control problems.
CO3	Understand and work with approximate solutions (e.g. Q-networks).
CO4	Learn the policy gradient methods from vanilla to more complex cases.
CO5	Recognize current advanced techniques and applications in RL.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 Introduction to Reinforcement Learning – Overview of reinforcement learning concepts and terminology, Markov Decision Processes (MDPs) and Bellman equations, Dynamic programming relation to RL, Value and policy iteration algorithms.	**6**
Module 2	**6**

Temporal Difference Learning – TD prediction and TD (0) algorithm, SARSA and Q-learning algorithms, Off-policy and on-policy learning.	
Module 3 Function Approximation in RL – Linear function approximation, Feature engineering for RL, Deep Q-Networks (DQN).	**6**
Module 4 Policy Gradient Methods – Policy parameterization and policy gradients, REINFORCE algorithm, Proximal Policy Optimization (PPO).	**6**
Module 5 Exploration strategies: epsilon-greedy, UCB, Thompson sampling, Multi-armed bandits and contextual bandits, Upper Confidence Bound (UCB) algorithm.	**6**

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019

REFERENCE BOOKS:

1. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
2. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3..
3. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.
4. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	2	3	2
CO2	3	3	3	1	3	1	1	1				2	2	2	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self- learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

Course Code	: **CN423**
Course Title	**: FEATURE ENGINEERING**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits:3 L:3 T:0	**P:0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: VIII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Extract useful features from data and convert them to features.
B.	Learn how to deal with infrequent, rare, and unseen categories.
C.	Learn to transform categorical variables into numbers while capturing meaningful information.
D.	Learn to convert numerical variables into discrete ones.
E.	Learn techniques to pre-process data and build more powerful machine learning models.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Create new features from existing ones.
CO2	Impute missing data and encode categorical variables.
CO3	Transform numerical variables and change their distribution.
CO4	Perform discretization, remove outliers, and extract features from date & time.
CO5	Reduce dimensionality of data using PCA.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Introduction to Feature Engineering, Importance of feature engineering, Evaluation of machine learning algorithm and Feature engineering procedures. **Feature Understanding:** Feature Improvement-cleaning datasets, Feature Selection-removing bad attributes, Feature construction, Feature Transformation, Feature learning.	**8**
Module 2 **Data Pre-processing and Missing Values:** Handling missing values, identification, imputation techniques (mean, median, regression-based), and impact on models. **Basics of Feature Representation:** Scalars and Vectors, Dealing with Counts, Binarization, Quantization or Binning, Log Transformation, Feature Scaling or Normalization, Min-Max Scaling, Standardization (Variance Scaling).	**8**

Module 3 **Encoding and Transformation Techniques** Handling categorical variables: one-hot encoding, label encoding, and target encoding, Handling text data: bag-of-words representation, TF-IDF encoding, and word embeddings. **Numerical transformations:** handling skewed distributions, logarithmic transformations, and scaling techniques. Binning and discretization of continuous variables.	**8**
Module 4 **Feature Selection:** Importance of Feature Selection in Machine Learning, Goals of Feature Selection, Classes of Feature Selection Methodologies. Effect of Irrelevant Feature, Univariate feature selection: statistical tests and feature importance, Recursive Feature Elimination, Stepwise Selection.	**8**
Module 5 **Feature Transformations:** Intuition, Derivation, Linear Projection, Variance and Empirical Variance - Vector Formulation, General Solution of the Principal Components, Transforming Features, Implementing PCA, PCA in Action, Considerations and Limitations of PCA, Use Cases	**8**

TEXT BOOKS:

1. Max Kuhn , Kjell Johnson, "Feature Engineering and Selection: A Practical Approach for Predictive Models" 1st Edition, Chapman & Hall/CRC Data Science Series, ISBN 13- 978-1-138-07922-9.
2. Sinan Ozdemir, Divya Susarla, "Feature Engineering Made Easy", Packt Publishing, ISBN 978-1-78728-760-0

REFERENCE BOOKS:

1. Alice Zheng & Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques for data scientist", Oreilly Publications

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Use of techniques for Multivariate missing data imputation and engineering mixed variables.
2. Assembling a feature engineering pipeline.

POs met through Gaps in the Syllabus - 1, 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

3. Outlier handling
4. Use of Clustering algorithms for feature engineering
5. Image data feature engineering

POs met through Topics beyond syllabus/Advanced topics/Design - 1, 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN414**
Course Title : **ADVANCE DATA ANALYTICS LAB**
Pre-requisite(s) : **Data Analytics Lab**
Co- requisite(s) : **Advanced Data Analytics**
Credits:2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know the data and its characteristics.
B.	Understand data relationship, advanced data analysis: classification clustering.
C.	Understand association rules extraction from the transaction data sets using various methods.
D.	Identify Time series data analysis for forecasting.
E.	Learn text data analysis.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Get the insight about the data.
CO2	Establish the Data relationship and able to analyze the data in more advance way.
CO3	Getting the analysis of transaction data to extract the associative patterns.
CO4	Forecasting about the future using the time series data analysis.
CO5	The documents classification and clustering based on the similarity's measures.

Syllabus

List of Programs as Assignments:
1. Program on data reading and writing using csv file.
2. Program on Data visualization: Various charts and Graphs.
3. Program on Data Normalization: Max-min normalization and Standard normalization.
4. Program on Dimensional reduction using principal component analysis.
5. Program on Correlation analysis to compute the Pearson coefficient of correlation.
6. Program on Correlation analysis to compute the Spearman coefficient of correlation.
7. Program on simple Regression and multiple Regression Analysis.
8. Program on data classification using Bayesian classifiers.
9. Program on data classification using logistic regression.
10. Program on data clustering using KMeans and KMedoids method.
11. Program on data clustering using Hierarchical method.
12. Program on Time series data analysis to know the characteristic of time series data.
13. Program on Time series data analysis for future forecasting.
14. Program on document Classification and Clustering.
15. Program on sentiments analysis of documents.

TEXT BOOKS:

1. Sayan Mukhopadhyay, "Advanced Data Analytics Using Python", Apress, 2018
2. Dipanjan Sarkar, "Text Analytics with Python", Apress, 2016

REFERENCE BOOKS:

1. Han J and Kamber M, "Data Mining: Concepts and techniques", Morgan Kaufmann Publishers. 2nd and 3rd Edition.
2. Gupta and Gupta, "Business Statistics", Sultan Chand and Sons, 2014.
3. Maheshwari Anil, "Data Analytics", Mc Graw hill publication, 2017.

Gaps in the Syllabus (to meet Industry/Profession requirements)

Working on real life data collected from the industries and institutions.

POs met through Gaps in the Syllabus - 6, 9, 11 and 12

Topics beyond syllabus/Advanced topics/Design

1. Some other classification and clustering techniques
2. Web data scraping and its analysis

POs met through Topics beyond syllabus/Advanced topics/Design - 5, 8, 11, and 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	2	2	2	1	1	1	1	1	2	3
CO2	3	3	2	2	1	3	1	1	2	1	1	2	3	2	3
CO3	3	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	3	3	3	3	3	1	3	1	3	1	3	3	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD4 CD8 CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4 CD8 CD5, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN422**
Course Title : **REINFORCEMENT LEARNING LAB**
Pre-requisite(s) :
Co- requisite(s) : **Reinforcement Learning**
Credits: 2 L: 0 T:0 P:4
Class schedule per week :**04**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the foundations of Reinforcement Learning.
B.	Learn reinforcement learning algorithms.
C.	Gain hands-on experience with RL frameworks.
D.	Evaluate and compare RL algorithms.
E.	Experiment with hyperparameter tuning.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Explain the fundamental concepts and principles of reinforcement learning, including Markov Decision Processes (MDPs), Bellman equations, and value/policy iteration.
CO2	Develop the ability to implement and apply a variety of RL algorithms, such as temporal difference learning (e.g., SARSA, Q-learning), policy gradient methods, and function approximation techniques (e.g., Deep Q-Networks).
CO3	Apply RL techniques to solve real-world problems and practical applications, such as control tasks
CO4	Acquire practical skills by working with popular RL frameworks and libraries, such as OpenAI Gym, TensorFlow, or PyTorch, to design, train, and evaluate RL agents.
CO5	Gain experience in tuning hyperparameters of RL algorithms to optimize their performance, including learning rates, discount factors, exploration rates.

Syllabus

List of Experiments
1. Implement a basic MDP framework and solve a simple grid world problem
2. Implement Tic-tac-Toe using RL
3. Implement SARSA algorithm and evaluate their performance on a classic RL benchmark, such as the FrozenLake environment
4. Implement Q-learning algorithm and evaluate their performance on a classic RL benchmark
5. Implement a DQN agent using a deep neural network to solve a continuous control task in the OpenAI Gym environment, such as CartPole or LunarLander
6. Implement the Actor-Critic Model
7. Implement the REINFORCE algorithm for training an RL agent on a continuous action space environment, such as the Pendulum or BipedalWalker

8. Implement the Proximal Policy Optimization (PPO) for training an RL agent on a continuous action space environment, such as the Pendulum or BipedalWalker
9. Compare and contrast the Reinforcement algorithm and PPO for training an RL agent
10. Implement one policy gradient method.
11. Implement the Upper Confidence Bound (UCB) algorithm and compare its performance with other exploration strategies on a multi-armed bandit problem

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press, 2019
2. Reinforcement Learning: With Open AI, TensorFlow and Keras Using Python by Abhishek Nandy, Manisha Biswas, 1st Edition, Apress, 2017

REFERENCE BOOKS:

1. Applied Reinforcement Learning with Python: With OpenAI Gym, Tensorflow and Keras. by Taweh Beysolow II, APress, 2019.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (Pos)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	1	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD8, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2, CD9
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self- learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

Course Code	: **CN 424**
Course Title	: **FEATURE ENGINEERING LAB**
Pre-requisite(s)	: **Python Programming Lab**
Co- requisite(s)	: **Feature Engineering**
Credits: 2 L:0 T:0	**P:4**
Class schedule per week	: **04**
Class	: **BCA**
Semester / Level	: **VIII/4**
Branch	: **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the different types of features.
B.	Select features that are relevant and informative for machine learning algorithms.
C.	Evaluate the effectiveness of feature engineering.
D.	Apply feature engineering techniques to real-world data.
E.	Do the feature engineering for numerical, text, image, audio and time series data.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Handle the missing values using different imputation techniques and indicator techniques.
CO2	Apply encoding techniques for categorical data and handle the text data.
CO3	Apply different feature selection methods.
CO4	Apply outlier engineering and feature transformations.
CO5	Apply feature engineering on time series data and domain specific data.

Syllabus

List of Programs as Assignments:

1. Missing Values:
    - Imputation Techniques: Implement different methods such as mean, median, mode, or regression-based imputation to fill in missing values.
    - Indicator Variables: Create binary indicator variables to represent missingness in categorical or numerical features.
2. Encoding Categorical Variables:
    - One-Hot Encoding: Convert categorical variables into binary vectors.
    - Label Encoding: Assign a unique numerical label to each category.
3. Numerical Transformations:
    - Logarithmic Transform: Apply logarithmic transformation to handle skewed distributions.
    - Scaling: Normalize numerical features using techniques like standardization (mean 0, standard deviation 1) or min-max scaling (range between 0 and 1).
    - Binning: Convert continuous variables into discrete bins to capture non-linear relationships.
4. Date and Time Features:
    - Extract Components: Break down dates into day, month, year, or extract time-based features like hour of the day, day of the week, etc.

- Time Since/Until: Calculate the time duration between two dates or events.

5. Textual Data:
    - Bag-of-Words: Convert text into numerical vectors based on word frequency.
    - TF-IDF Encoding: Assign weights to words based on their importance in a document or corpus.
6. Interaction Features:
    - Polynomial Features: Generate higher-order polynomial terms to capture non-linear relationships between features.
    - Interaction Terms: Create new features by multiplying or combining existing features.
7. Feature Selection:
    - Univariate Selection: Use statistical tests like chi-square, ANOVA, or correlation coefficients to select relevant features.
    - Recursive Feature Elimination: Iteratively remove less important features based on model performance.
    - Dimensionality Reduction: Apply techniques like Principal Component Analysis (PCA) to reduce feature dimensionality.
8. Time-based Features:
    - Rolling Statistics: Calculate statistical measures (mean, max, min, etc.) over a rolling window of time.
    - Lagged Variables: Include past values of a feature as additional input, capturing time-dependent patterns.
9. Domain-Specific Feature Engineering:
    - Create domain-specific features based on prior knowledge of the problem domain on a suitable dataset.
10. Feature Crosses:
    - Combine multiple features to create new composite features. For example, if you have features A and B, create a new feature by multiplying A and B or concatenating their values.
11. Grouping and Aggregating:
    - Group data by a categorical feature and calculate aggregate statistics such as mean, sum, count, etc., on numerical features within each group. These aggregated features can capture group-level information.
12. Target-Related Features:
    - Create features based on the relationship between a feature and the target variable. For example, compute the mean or standard deviation of a numeric feature for different values of the target variable.
13. Time-Series Features:
    - Derive features specific to time-series data, such as moving averages, exponential smoothing, autocorrelation, or seasonality indicators.
14. Outlier Engineering:
    - Identify and handle outliers by transforming or capping extreme values. For instance, replace outliers with the median or mean, or create binary indicator variables to capture the presence of outliers.
15. Domain-Specific Transformations:
    - Apply domain-specific transformations to features. For example, on geographical data, you can calculate distances between points or create clusters based on spatial proximity.
16. Time Since Last Event:
    - Calculate the time duration since the occurrence of specific events or actions, which can capture recency information.

17. Composite Features:
    - Create composite features by combining multiple existing features using mathematical operations (e.g., addition, subtraction, multiplication, division).

REFERENCE BOOKS:

1. Max Kuhn , Kjell Johnson, "Feature Engineering and Selection: A Practical Approach for Predictive Models" 1st Edition, Chapman & Hall/CRC Data Science Series, ISBN 13- 978-1-138-07922-9.
2. Sinan Ozdemir, Divya Susarla, "Feature Engineering Made Easy", Packt Publishing, ISBN 978-1-78728-760-0
3. Alice Zheng & Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques for data scientist", Oreilly Publications

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Feature Extraction from Images: Utilize techniques such as convolutional neural networks (CNNs) or pre-trained models (e.g., ResNet) to extract meaningful features from images.
2. Feature Extraction from Audio: Extract audio features like Mel-frequency cepstral coefficients (MFCC), spectral contrast, or pitch-related features to represent audio data.
3. Feature Importance: Use model-based feature importance techniques like permutation importance or feature importance from tree-based models (e.g., random forests, gradient boosting) to identify the most influential features.

POs met through Gaps in the Syllabus - 1, 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Outlier handling
2. Use of Clustering algorithms for feature engineering
3. Image data feature engineering

POs met through Topics beyond syllabus/Advanced topics/Design - 1, 2, 3, 4, 12

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1				2	2	2	3
CO2	3	1	3	1	3	3	1	1				2	2	3	3
CO3	3	3	3	3	3	1	2	2		1	1	2	3	3	2
CO4	3	2	2	1	3		1	1		1	1	2	2	2	2
CO5	1	3	3	3	3	1	1	1	1	1	1	2	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD 4
CD2	Tutorials/Assignments	CO2	CD1, CD4
CD3	Seminars	CO3	CD1, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN417**
Course Title : **COMPUTER VISION**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the concepts of computer vision.
B.	Understand the various image processing methods used in computer vision.
C.	Learn about basic concepts of model fitting and optimization.
D.	Learn about deep learning concepts.
E.	Understand the various feature detection and matching techniques used in computer vision.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the various features of computer vision and basics of transformation techniques.
CO2	Apply different image processing techniques for solving real world computer vision problems and finding solutions.
CO3	Understand about the model fitting and optimization in computer vision world.
CO4	Explain the concepts of deep learning.
CO5	Implement the feature detection and matching techniques for various applications in computer vision.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction:** Overview of Computer Vision, Applications, Geometric Primitives and Transformations: 2D Transformations, 3D Transformations, 3D to 2D Projections, Photometric Image Formation: Digital Camera.	**7**
Module 2 **Image Processing:** Point Operators: Pixel Transforms, Color Transforms, Histogram Equalization, Linear Filtering, 2D Fourier Transforms, Geometric Transformations.	**8**
Module 3 **Model Fitting and Optimization:** Scattered Data Interpolation: Radial Basis Functions, Overfitting and Underfitting.	**6**

Module 4 **Deep Learning:** Supervised Learning: Nearest Neighbors, Bayesian Classification, Logistic Regression, Unsupervised Learning: Clustering, K-Means, Deep Neural Networks: Weights and Layers, Backpropagation, Convolutional Neural Networks.	**10**
Module 5 **Feature Detection and Matching:** Points and Patches: Feature Detectors, Feature Matching, Feature Tracking, Edges and Contours: Edge Detection, Contour Detection.	**5**

TEXT BOOKS:

1. Forsyth David A. and Ponce Jean, "Computer Vision. A Modern Approach", Pearson Education, 2015.
2. Szeleski R., "Computer Vision: Algorithms and Applications (Texts in Computer Science)", Springer.

REFERENCE BOOKS:

1. Hartley R. and Zisserman A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (Pos)												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	1	2	2	1	1	2	2	1	2	2	3	2	2
CO2	3	2	2	1	3	1	1	1	2	1	2	2	3	2	3
CO3	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3
CO4	3	2	3	2	3	1	2	2	3	2	2	2	3	3	3
CO5	3	3	3	2	3	1	2	2	2	2	2	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD3, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD3, CD6, CD8
CD3	Seminars	CO3	CD1, CD3, CD6, CD7
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3, CD6
CD5	Laboratory Experiments/Teaching Aids	CO5	CD2, CD6, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN419**
Course Title : **IMAGE PROCESSING**
Pre-requisite(s) : **Mathematics for Computing I**
Co- requisite(s) :
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the fundamentals of digital image processing.
B.	Develop a broad knowledge of different transform methods for enhancing the image.
C.	Learn Image restoration techniques and noise models used for restoring an image.
D.	Understand about image compression and image segmentation.
E.	Know about Object Recognition & learn techniques to perform the same.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand the concept of image formation, digitization, and the role which human visual system plays in perception of image data.
CO2	Acquire an appreciation for transform techniques for enhancing the appearance of an image and will be able to apply them in different applications.
CO3	Discern the difference between noise models, gain an insight into assessing the degradation function and apply noise removal technique.
CO4	Synthesize a solution to image compression.
CO5	Design pattern/object recognition system, evaluate its performance and apply improvement techniques.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 Introduction to Digital Image Processing: Fundamental Steps in Digital Image Processing, Components of an Image Processing System; Color Image: Fundamentals, Color Models & various image formats like bmp, jpeg, tiff, png, gif, etc.	**8**
Module 2 Digital Image Fundamentals: Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.	**8**

Module 3 Image Enhancement & Restoration: Image Enhancement: Basic intensity transformation function, Histogram Processing, Image degradation/Restoration Process, Noise Models, Restoration in the presence of noise only-Spatial Filtering	**8**
Module 4 Image Compression & Segmentation: Image Compression: Fundamentals, some basic compression methods; Image segmentation: Fundamentals, point, line & edge detection, thresholding, regionbased segmentation.	**8**
Module 5 Image Processing Applications: Object Recognition: Patterns & Patterns Classes, Recognition using Neural Network, matching shape numbers.	**8**

TEXT BOOKS:

1. Rafael. C. & Woods Richard E. "Digital Image Processing", 3rd Edition, Pearson Education, New Delhi, 2009.

REFERENCE BOOKS:

1. Pratt W.K. "Digital Image Processing", 4th Edition, John Wiley & sons Inc., 2006.
2. Sonka M., Hlavac Vaclav, Boyle Roger "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning, India Edition, 2007.
3. Jayaraman "Digital Image Processing", Tata McGraw. Hill Education, 2011.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	2	3	2
CO2	3	3	3	1	3	1	1	1				2	2	2	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

ANNEXURE B
DATA SCIENCE

SEMESTER VII/VIII

Course Code	: **CN425**
Course Title	**: NoSQL DATABASE**
Pre-requisite(s)	**: Database Management System**
Co- requisite(s)	**: NoSQL Database Lab**
Credits: 4 L: 3 T: 1	**P: 0**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII /4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the basic concepts and the applications of database systems. To master the basics of SQL and construct queries using SQL.
B.	Explore different types of NoSQL databases and understand the principles of relational database design.
C.	Understand the architecture of different types of databases.
D.	Become familiar with the basic issues of transaction processing and concurrency control.
E.	Become familiar with database storage structures and access techniques.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Explain and compare different types of NoSQL Databases.
CO2	Compare and contrast NoSQL databases with RDBMS.
CO3	Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL Databases.
CO4	Apply NoSQL development tools on different types of NoSQL database.
CO5	Demonstrate the architecture, define objects, load data and performance tune Column oriented, Document-oriented, Graph NoSQL databases.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module I **Introduction:** Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Point.	**8**
Module II **Evaluating NoSQL:** Introduction, The Technical Evaluation, Choosing NoSQL, Search Features, Scaling NoSQL, Keeping Data Safe, Visualizing NoSQL, Extending Data Layer, Business Evaluation, Deploying Skills, Deciding Open Source versus commercial software, Business critical features, Security.	**8**

Module III **Key-Value & Document Based Databases:** Introduction to Key-Value Databases, Key Value Store, Essential Features, Consistency, Transactions, Partitioning, Scaling, Replicating Data, Versioning Data, How to construct a Key, Using Keys to Locate Values, Hash Functions, Store data in Values, Use Cases, Introduction to Document Databases, Supporting Unstructured Documents, Document Databases Vs. Key-Value Stores, Basic Operation on Document database, Partition, Shading, Features, Consistency, Transactions, Availability, Scaling, Use Cases.	**8**
Module IV **Column-oriented & Graph based Databases:** Introduction to Column Family Database, Features, Architectures, Differences and Similarities to Key Value and Document Database, Consistency, Transactions, Scaling, Use Cases, Introduction to Graph Databases, Advantages, Features, Consistency, Transactions, Availability, Scaling, Graph & Network Modelling, Properties of Graphs and Noes, Types of Graphs, Undirected and directed Graph, Flow Network, Bipartite Graph, Multigraph, Weighted Graph, Conclusion of Unit.	**8**
Module V **Indexing and Ordering Data Sets:** Essential Concepts Behind A Database Index, Indexing And Ordering In Mongodb, Creating and Using Indexes In Mongodb, Indexing And Ordering In Couchdb, Indexing In Apache Cassandra.	**8**

TEXT BOOKS:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications.
2. NoSQL for Dummies, Adam Fowler, John Wiley & Sons.

REFERENCE BOOKS:

1. NoSQL for Mere Mortals, Dan Sullivan, Pearson Education.
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", Manning Publication/Dreamtech Press.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN431**
Course Title : **CLOUD COMPUTING**
Pre-requisite(s) : **Computer Networks, Operating System**
Co- requisite(s) :
Credits: 4 L: 3 T:1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII /4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand software, and other shared resources to be provisioned over the network as services in an on-demand manner.
B.	Comprehend the cloud computing models.
C.	Gain knowledge about the different types of cloud computing services namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software- as-a-Service (SaaS).
D.	Understand virtualization, security and privacy issues.
E.	Understand Cloud OS, federated clouds.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Describe the various aspects of cloud computing and distributed computing.
CO2	Understand the specifics of virtualization and cloud computing architecture.
CO3	Develop and deploy cloud application using services of different cloud computing technologies provider: Google app Engine, Amazon Web Services (AWS) and Microsoft Azure.
CO4	Provide recommendations on cloud computing solutions for a Green enterprise.
CO5	Identify and deploy appropriate design choices when solving real-world cloud computing problems.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module I Cloud Computing at a glance, Distributed Systems, Virtualization, Web 2.0, Service-oriented computing, Utility-oriented computing.	**8**
Module II Eras of Computing, Elements of Distributed Computing, Concepts of Virtualization and its characteristics, Virtualization and cloud computing, cloud reference model, types of clouds, economics of the cloud.	**8**

Module III Cloud Platforms in Industry: Amazon Web Services**:** Compute Services, Storage Services, Communication Services. Google AppEngine: Architectural and Core Concepts, Application Life-Cycle, Cost Model. Microsoft Azure: Azure Core Concepts, SQL Azure.	**8**
Module IV Energy-Efficiency in clouds, Energy-Efficient and Green Cloud Computing Architecture, Market- Oriented Cloud Computing, Federated clouds: characterization and definition, cloud federation stack. Cloud Security and Trust Management: Cloud Security Defense Strategies.	**8**
Module V Application of clouds in: Health care, Biology, CRM, ERP, Social Networking, Productivity and Geoscience. Cloudlets for Mobile Cloud Computing.	**8**

TEXT BOOKS:

1. Buyya Rajkumar, Charles, Vecchiola Christianamd Selvi S. Thamarai "Mastering Cloud Computing", McGraw Hill Education (India) Private Limited.

REFERENCE BOOKS:

1. Hwang Kai, Fox Geoffrey C., Dongarra Jack J., "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	1	1	1	1	1	1	1	1	1	1	2	2	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	2	3	2	1
CO3	3	3	3	1	3	1	1	1	1	1	1	3	3	3	1
CO4	3	1	1	1	1	1	3	1	1	1	1	2	3	2	1
CO5	3	3	3	1	2	1	1	1	1	1	1	3	3	3	1

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN426**
Course Title : **NoSQL LAB**
Pre-requisite(s) :
Co- requisite(s) : **NoSQL Database**
Credits: 2 L:0 T: 0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Setup and configure the lab environment.
B.	Make use of different commands in the lab environment.
C.	To create and implement shards.
D.	Understand the model of system existing in various IT companies.
E.	Using and learning the MongoDB environment.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Design a database for a given set of requirements.
CO2	Use NoSQL and its various commands.
CO3	Apply commands on given database.
CO4	Have knowledge of creating, adding shards to the structure.
CO5	Understand the importance of migration to NoSQL.

SYLLABUS

List of Programs as Assignments:
Below experiments can be performed on MongoDB Lab by creating single node cluster.

1. Prepare and install infrastructure for setting up MongoDB lab.
2. Execute set of basic commands on MongoDB lab environment
   a. Login
   b. Display all databases.
   c. Authenticate and logout from databases.
   d. List down collections, users, roles
3. Execute set of basic commands on MongoDB lab environment
   a. Insert document.
   b. Update document
   c. Save document.
   d. Display collection records
   e. Drop function.
4. XYZ Pvt Ltd. is a famous telecom company. They have customers in all locations. Customers use the company's network to make calls. Government has brought in a regulation that all telecom companies should store call details of their customers. This is very important from a security point of view and all telecom companies have to retain this data for 15 years. The company already stores all customer details data, for their analytics

team. But due to a surge in mobile users in recent years, their current database cannot handle huge amounts of data.
Current database stores only six months of data. XYZ Pvt Ltd now wants to scale their database and wants to store 15 years of data.
Data contains following columns:
Source: Phone number of caller
Destination: Phone number of call receiver
Source_location: Caller's city
Destination_location: Call receiver's city
Call_duration: phone call duration
Roaming: Flag to check if caller is in roaming
Call_charge: Money charged for call

5. After discussing the requirements with database and architecture team, it has been decided that they should use MongoDb. You have been given the task to Setup a distributed system (database) such that data from different locations go to different nodes (to distribute the load)
   a. Import data to sharded collection.
   b. Check data on each shard for distribution.
6. Execute below sets of problem by taking reference of previous experiment and find out:
   a. Add additional node to existing system.
   b. Check the behavior of cluster on adding a shard.
   c. Check the behavior of query for finding a document with source location Delhi.
7. Case study on 5 different IT Companies who are working on Mongo DB. Explain on the below parameters:
   a. Why moved to NoSQL
   b. Advantages over NOSQL
   Business Benefits Technology Adaptation

TEXT BOOKS

1. "Getting Started with NoSQL: Your guide to the world and technology of NoSQL", by Gaurav Vaish, Packt Publishing.

REFERENCE BOOKS

1. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	: **CN432**
Course Title	**: CLOUD COMPUTING LAB**
Pre-requisite(s)	**: Computer Networks, Operating System**
Co- requisite(s)	**: Cloud Computing**
Credits: 2 L: 0 T: 0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand software, and other shared resources to be provisioned over the network as services in an on-demand manner.
B.	Comprehend the cloud computing models.
C.	Gain knowledge about the different types of cloud computing services namely, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software- as-a-Service (SaaS).
D.	Understand virtualization, security and privacy issues.
E.	Identify and deploy appropriate design choices when solving real-world cloud computing problems.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Configure various virtualization tools such as Virtual Box, VMware workstation.
CO2	Use Infrastructure and Platform services provided by AWS.
CO3	Learn server less computing using AWS Lambda function.
CO4	Understand concepts of Identity management using AWS IAM.
CO5	Create a virtual private cloud.

Syllabus

List of Programs as Assignments:

1. Install VirtualBox/VMware Workstation with different flavors of Linux or Windows OS
2. Create Amazon AWS EC2 Linux instance with conceptual understanding of SSH
3. software protocol and keys.
4. Configure WebServer on Amazon Linux Instance.
5. Create cloud storage bucket using Amazon Simple Storage Service (S3).
6. Launch and connect to Amazon Relational Database Service (RDS).
7. Host your application in the cloud using AWS Elastic Beanstalk.
8. Create an AWS Lambda Function and an event to trigger it.
9. Explore **AWS Identity and Access Management Users, Groups and Policies.**
10. Create VPC using Amazon Virtual Private Cloud.
11. Assign Elastic IP Address to a EC2 instance.

TEXT BOOKS:

1. Buyya Rajkumar, Charles, Vecchiola Christianamd Selvi S. Thamarai "Mastering Cloud Computing", McGraw Hill Education (India) Private Limited.

REFERENCE BOOKS:

1. Hwang Kai, Fox Geoffrey C., Dongarra Jack J., "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Morgan Kaufmann - India Edition.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	2	1	3	1	1	1	1	1	1	2	3	2	1
CO2	3	1	3	1	3	1	1	1	1	1	1	2	3	3	1
CO3	3	2	3	1	3	1	1	1	1	1	1	2	3	3	1
CO4	3	1	1	1	3	1	1	1	1	1	1	2	2	2	1
CO5	3	2	3	1	3	1	1	1	1	1	1	2	3	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5
CD3	Seminars	CO3	CD1, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN433**
Course Title	**: DATA PREPROCESSING AND REPORTING**
Pre-requisite(s)	**: Introduction to Data Science**
Co- requisite(s)	**: Data Preprocessing and Reporting Lab**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 4**
Class	**: BCA**
Semester / Level	**: VII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know the basics of data Pre-processing and Reporting.
B.	Know the basics for data cleaning and Integration.
C.	Translate and present data in standard form and selecting the features.
D.	Have an understanding of handling the categorical and imbalanced data.
E.	Learn to wisely use various data visualization techniques such as plots, chart graphs and reporting of data analysis results.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Demonstrate understanding of Data Pre-processing and Reporting basics.
CO2	Demonstrate skills on Data Cleaning and Integration process.
CO3	Apply pre-processing techniques for various data analysis tasks.
CO4	Demonstrate understanding of handling of categorical and imbalanced techniques.
CO5	Demonstrate skills in using different types of visualization and reporting tools and techniques.

SYLLABUS

MODULE	**(NO. OF LECTURE HOURS)**
Module I Introduction to Data Preprocessing Overview of the data analysis process, Importance of data pre-processing and reporting, Ethical considerations in data handling and reporting.	**8**
Module II Data Cleaning and Integration Handling missing data: techniques and imputation methods, Dealing with outliers: detection and treatment strategies, Data integration: merging datasets, resolving inconsistencies.	**8**
Module III Data Transformation and Feature Selection	**8**

Data normalization and standardization, Log transformations and power transformations, Feature selection: identifying relevant variables.	
Module IV Handling Categorical Data and Data Splitting Encoding categorical variables: one-hot encoding, label encoding, Train-test split: dividing data for model development and evaluation, Handling imbalanced datasets: techniques for addressing class imbalance.	**8**
Module V Data Visualization, Reporting, and Interpretation Introduction to data visualization techniques: plots, charts, and graphs, Descriptive statistics: calculating and interpreting summary statistics, Exploratory data analysis (EDA): identifying patterns and relationships, Reporting and communication of data analysis results.	**8**

TEXT BOOKS:

1. Data Science for Business, Authors: Foster Provost and Tom Fawcett, Publisher: O'Reilly Media, Year: 2013
2. Practical Data Cleaning, Author: Lee Baker, Publisher: Kindle Edition
3. Data Preparation for Data Mining, Author: Dorian Pyle, Publisher: Morgan Kaufmann, Year: 1999 (Revised edition in 2011)
4. Python Data Science Handbook, Author: Jake VanderPlas, Publisher: O'Reilly, Year: 2016
5. Storytelling with Data, Author: Cole Nussbaumer Knaflic, Publisher: Wiley, Year: 2015

REFERENCE BOOKS:

1. Feature Engineering for Machine Learning, Author: Alice Zheng and Amanda Casari, Publisher: O'Reilly, Year: 2018
2. Data Wrangling with Python, Author: Sarkar Dr. Tirthajyoti, Publisher: Packt Publisher, Year: 2019

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	2	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD8,
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD4, CD5, CD9
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN434**
Course Title	**: DATA PREPROCESSING AND REPORTING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Data Preprocessing and Reporting**
Credits:2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Know about the data preprocessing and reporting process.
B.	Different categories of datasets, datatypes, and attribute-types.
C.	Understand the different techniques of data preprocssing.
D.	Real life applications of data preprocessing functionalities.
E.	Decide what data reporting techniques are required to obtain the desired objectives.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Basics of suitable tool to implement the data preprocessing and reporting process.
CO2	Methods and metrics of descriptive and visual data analysis.
CO3	Implement the techniques of different data preprocessing functionalities using suitable packages/ libraries/ tools.
CO4	Conduct projects to solve real life problems using the data preprocessing methods and tools.
CO5	Demonstrate the use of various data visualization and reporting tools.

Syllabus

List of Programs as Assignments:

Exercise 1: You have a dataset that contains information about customers, including their age, income, and purchase history. However, the dataset contains missing values in some of the columns. Your task is to handle the missing values appropriately.
a) Load the dataset into a pandas DataFrame.
b) Check for missing values in each column.
c) Decide on a strategy to handle the missing values. You can either remove the rows with missing values or impute the missing values with appropriate values.
d) Implement your chosen strategy and update the dataset accordingly.

Exercise 2: You have a dataset that contains text data, and you want to pre-process it for natural language processing tasks.
a) Load the dataset into a pandas DataFrame.
b) Remove any special characters, numbers, and punctuation marks from the text.
c) Convert the text to lowercase.
d) Tokenize the text into individual words.
e) Remove stop words from the text.
f) Apply stemming or lemmatization to reduce words to their base form.
g) Update the dataset with the preprocessed text.

Exercise 3: You have a dataset that contains categorical variables encoded as strings. However, for some categorical variables, there are typos and inconsistent capitalization.
a) Load the dataset into a pandas DataFrame.
b) Examine the unique values in each categorical column to identify any inconsistencies.
c) Clean the categorical variables by correcting the typos and ensuring consistent capitalization.
d) Encode the categorical variables using one-hot encoding or label encoding.
e) Update the dataset with the cleaned and encoded categorical variables.

Exercise 4: You have a dataset that contains numerical features, but some of the features are skewed and have a wide range of values.
a) Load the dataset into a pandas DataFrame.
b) Examine the distribution of each numerical feature using histograms or density plots.
c) Apply a transformation technique (such as logarithmic transformation or Box-Cox transformation) to reduce skewness and make the distribution more symmetric.
d) Scale the numerical features to a similar range using techniques like min-max scaling or standardization.
e) Update the dataset with the transformed and scaled numerical features.
Exercise 5: Data Visualization and Reporting
a. Select a dataset of interest for analysis and reporting.
b. Identify the main message or insights you want to communicate.
c. Choose appropriate visualization techniques to support your message (e.g., bar charts, line graphs, scatter plots).
d. Create visually appealing and informative charts using data visualization tools (e.g., matplotlib, Tableau, Power BI).
e. Organize your findings into a cohesive report, incorporating visualizations, text explanations, and key takeaways.
**Import the necessary libraries (such as pandas, numpy, and sklearn) to perform these exercises.

TEXT BOOKS:

1. Hands-On Data Preprocessing in Python, by Roy Jafari, Publisher(s): Packt Publishing, 2022
2. Data Preprocessing in Data Mining" by Salvador García and Julián Luengo, Springer International Publishing Switzerland 2015.
3. Data Wrangling with Python" by Jacqueline Kazil and Katharine Jarmul,O'Reilly Media Inc., 2016

REFERENCE BOOKS:

1. "Storytelling with Data: A Data Visualization Guide For Business Professionals", by Cole Nussbaumer Knaflic, Wiley,2015

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	1	3	3	1	3	1	1	1				2	2	2	3
CO2	3	2	3	1	3	3	1	1				2	3	2	2
CO3	1	3	3	3	3	1	2	2		1	1	2	2	2	2
CO4	3	2	2	1	3		1	1		1	1	2	2	3	2
CO5	1	3	3	3	3	1	1	1	1	1	1	2	2	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD4, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD4, CD5
CD3	Seminars	CO3	CD1, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN427**
Course Title : **DATA ETHICS AND PRIVACY**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII /4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Explore the ethical dimensions and privacy implications of data-driven technologies.
B.	Focus on the responsible collection, analysis, storage, and use of data.
C.	Explore strategies for promoting responsible data practices.
D.	Understand societal implications of data ethics.
E.	Understand the ethical frameworks and privacy concerns.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the fundamental concepts and principles of data ethics and privacy.
CO2	Identify ethical issues and challenges associated with data-driven technologies.
CO3	Apply ethical frameworks and guidelines to address data ethics and privacy concerns.
CO4	Develop strategies for promoting responsible data practices and protecting privacy.
CO5	Analyze the impact of biases and fairness in data-driven decision-making.

Syllabus

MODULES	**(NO. OF LECTURE HOURS)**
Module I Introduction to Data Ethics, Overview of data ethics and its importance, Key ethical principles and frameworks, Privacy rights and legal considerations, Ethical Issues in Data Collection, Informed consent and data transparency, Data anonymization and de-identification, Ethical considerations in data sharing and aggregation.	**8**
Module II Ethical Data Analysis and Use Responsible data analysis practices, Ethical considerations in AI and machine learning Data-driven decision-making and accountability, Bias and Fairness in Data, Types of bias in data and algorithms, Implications of biased data and algorithmic decision-making.	**8**
Module III	**6**

Ethical Guidelines and Frameworks, International and industry-specific data ethics guidelines, Ethical considerations for data scientists and practitioners, Corporate social responsibility and ethical data governance.	
Module IV Privacy and Data Protection, Data breaches and security risks, Privacy-enhancing technologies and techniques, Privacy regulations and compliance (e.g., GDPR, CCPA).	**6**
Module V Social Impact of Data Ethics and Privacy, Surveillance society and implications for civil liberties, Ethical considerations in data-driven research and public policy, Ethical implications of data-driven business models.	**6**

TEXT BOOKS:

1. "Ethics of Big Data" by Kord Davis and Doug Patterson
2. "Privacy in Context: Technology, Policy, and the Integrity of Social Life" by Helen Nissenbaum
3. "Data Ethics: The New Competitive Advantage" by DJ Patil

REFERENCE BOOKS:

1. "Responsible Data Science" by Foster Provost and Panos Ipeirotis
2. "Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor" by Virginia Eubanks

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	2	3	2	2	2	3	2
CO2	3	3	3	1	3	1	1	1	2	2	4	2	2	2	2
CO3	3	3	3	3	3	1	2	2	3	1	1	2	2	3	2
CO4	3	3	3	1	3	2	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD3, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD6, CD7, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN429**
Course Title	**: CRYPTOGRAPHY & NETWORK SECURITY**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 4 L:3 T:1	**P:0**
Class schedule per week	**: 4**
Class	**: BCA**
Semester / Level	**: VII//4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the functions of cryptographic attacks.
B.	Gain knowledge of symmetric cryptographic techniques.
C.	Enhance knowledge of asymmetric cryptographic techniques.
D.	Differentiate between the cryptographic techniques and know their suitability to an application.
E.	Prepare students for research in the area of cryptography & network security and enhance problem solving skills.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the various types of cryptographic attacks and the mathematics behind cryptography.
CO2	Apply the symmetric cryptographic techniques to solve real life problems.
CO3	Apply the asymmetric cryptographic techniques to solve real life problems.
CO4	Describe digital certificates and PKIX model.
CO5	Analyze all relevant aspects of security in networks like E-mail security, PEM& S/MIME, PGP, Firewalls.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module I **Introduction**: Security goals, Principles of Security, Cryptographic attacks, Mathematics of cryptography. **Cryptography: Concepts and Techniques:** Introduction, Plain Text and Cipher Text, Substitution Techniques, Transposition Techniques, Encryption and Decryption, Symmetric and Asymmetric Key Cryptography, Steganography, Key range and Key Size, Possible Types of Attacks.	**8**
Module II **Symmetric Key Algorithms and AES:** Introduction, Algorithm Types and Modes, An Overview of Symmetric Key Cryptography, Data Encryption Standard (DES), International Data Encryption Algorithm (IDEA), RC4, RC5, Blowfish, Advanced Encryption Standard (AES).	**8**

Module III **Asymmetric Key Algorithms, Digital Signatures and RSA:** Introduction, Brief History of Asymmetric Key Cryptography, An Overview of Asymmetric Key Cryptography, The RSA Algorithm, Symmetric and Asymmetric Key Cryptography Together, Digital Signatures, Knapsack Algorithm.	**8**
Module IV **Digital Certificates and Public Key Infrastructure (PKI)**: Introduction, Digital Certificates, Private Key Management, The PKIX Model, Public Key Cryptography Standards (PKCS), XML, PKI and Security.	**8**
Module V **Network Security:** System Security- Users, Trusts and Trusted systems. Malicious Software. Intrusion Detection system (IDS). Firewalls. Security at the Network layer: IPSec Security at the Transport layer: SSL and TLS Security at the Application layer: PGP and S/MIME	**8**

TEXT BOOKS:
1. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill Publication.

REFERENCE BOOKS:
1. Behrouz A. Forouzan and D. Mukhopadhyay, Cryptography & Network Security, TMH.
2. William Stalling, Cryptography and Network Security – Principle & Practice, Pearson.

Gaps in the Syllabus (to meet Industry/Profession requirements)
1. Real-time use cases and applications of cryptography.

POs met through Gaps in the Syllabus – PO2, PO3 and PO5

Topics beyond syllabus/Advanced topics/Design
1. Industry based use-case.

POs met through Topics beyond syllabus/Advanced topics/Design – PO5

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment
1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	1	1	1	2	2	1	1	1	2	1	2	3	1	1
CO2	3	3	3	3	2	2	2	2	2	2	2	3	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	2	1	1	1	2	1	2	3	1	1
CO5	3	2	2	3	2	2	1	1	2	2	1	3	3	3	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD6, CD9
CD3	Seminars	CO3	CD1, CD2, CD5, CD6, CD9
CD4	Mini Projects/Projects	CO4	CD1, CD3, CD7, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD6
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN437**
Course Title : **DATA SECURITY**
Pre-requisite(s) :
Co- requisite(s) : **Data Security Lab**
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course envisions to impart to students to:

A.	Able to understand fundamentals of cryptography and its application to network security.
B.	Able to understand E-mail security, PEM& S/MIME, PGP, Firewalls.
C.	Understand network security threats, security services, and countermeasures.
D.	Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.
E.	Understand vulnerability analysis of network security and able to be introduced to new developing security features.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Identify state-of-the-art and open problems in network security.
CO2	Analyze all relevant aspects of security in networks like E-mail security, PEM & S/MIME, PGP, Firewalls.
CO3	Assess the impact of Modes of Operation and problems in network.
CO4	Summaries developing security features in networking systems and Real time communication security.
CO5	Design of secure system and applications.

SYLLABUS

MODULE	**(NO. OF LECTURE HOURS)**
Module – I **Introduction,** Security Concepts, Challenges, Security architecture, Security attacks, security.	**8**
Module – II **Error detecting/correction:** Block Codes, Generator Matrix, Parity Check Matrix, Minimum distance of a Code, Error detection and correction, Standard Array and syndrome decoding, Hamming Codes.	**8**
Module – III	**8**

Cryptography: Encryption, Decryption, Substitution and Transposition, Confusion and diffusion, Symmetric and Asymmetric encryption, Stream and Block ciphers, DES, cryptanalysis. Public-key cryptography, Diffie-Hellman key exchange, man-in-the-middle attack Digital signature, Steganography, Watermarking.	
Module – IV **Malicious software's:** Types of malwares (viruses, worms, trojan horse, rootkits, bots), Memory exploits - Buffer overflow, Integer overflow.	**8**
Module – V **Security in Internet-of-Things:** Security implications, Mobile device security - threats and Strategies, E mail security, PEM& S/MIME, PGP, Firewalls – Design and Types of Firewalls, Personal Firewalls.	**8**

TEXT BOOKS:

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson.
3. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.

REFERENCE BOOKS:

1. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini projects / Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD9
CD6	Industrial/guest lectures		
CD7	Industrial visits/ in-plant training		
CD8	Self-learning such as use of NPTEL materials and internets		
CD9	Simulation		

Course Code	**: CN438**
Course Title	**: DATA SECURITY LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Data Security**
Credits:2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VIII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course envisions to impart to students to:

A.	Understand the principles of web security and to guarantee a secure network by monitoring and analyzing the nature of attacks through cyber/computer forensics software/tools.
B.	Exhibit knowledge to secure corrupted systems, protect data and secure computer networks in an organization.
C.	Understand network security threats, security services, and countermeasures.
D.	Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.
E.	Have the ability to compare merits and demerits of techniques and take decisions while securing a network.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Analyse and evaluate the Cyber security needs of an organization.
CO2	Analyse all relevant aspects of security in networks like E-mail security, PEM & S/MIME, PGP, Firewalls.
CO3	Measure the performance and troubleshoot cyber security systems.
CO4	Summarise developing security features in networking systems.
CO5	Implementation of Secure system applications.

Syllabus

List of Programs as Assignments:

1. Implement the error correcting code.
2. Implement the error detecting code.
3. Implement caeser cipher substitution operation.
4. Implement monoalphabetic and polyalphabetic cipher substitution operation.
5. Implement playfair cipher substitution operation.
6. Implement hill cipher substitution operation.
7. Implement rail fence cipher transposition operation.
8. Implement row transposition cipher transposition operation.
9. Implement product cipher transposition operation.
10. Illustrate the Ciphertext only and Known plaintext attacks.
11. Implement a stream cipher technique

TEXT BOOKS

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson.

REFERENCE BOOK

1. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
2. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	1	1	2	2	1	1	1	1	1	2	2
CO2	3	1	1	1	1	3	1	1	2	1	1	2	3	2	3
CO3	2	3	3	1	2	1	2	2	1	1	1	2	2	2	3
CO4	1	1	3	3	1	1	1	1	1	1	1	1	2	3	3
CO5	3	3	3	1	2	1	1	2	1	1	2	1	1	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping between COs and Course Delivery (CD) methods

CD	Course Delivery methods	Course Outcome	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD8, CD9
CD3	Seminars	CO3	CD1, CD2, CD5
CD4	Mini projects / Projects	CO4	CD1, CD5, CD8, CD9
CD5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD9
CD6	Industrial/guest lectures		
CD7	Industrial visits/ in-plant training		
CD8	Self-learning such as use of NPTEL materials and internets		
CD9	Simulation		

Course Code : **CN435**
Course Title : **BIG DATA ANALYTICS**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L: 3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the concepts related to Big Data and Artificial Intelligence for data driven decision making.
B.	Understand the explosion of big data in organizations & cultural transformation.
C.	Understand Big data & AI tools & technologies available in market.
D.	Explain the merits and limitations of different Big data architectures.
E.	Apply these concepts to solve real world problems.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Ability to recognize related technologies like AI, IoT and Digital Reality.
CO2	Ability to define big data & explain the various V's of Big Data.
CO3	Understand the application of AI for Executives.
CO4	Understand the people component of AI & Big Data.
CO5	Understand the analytical aspects of Big Data.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module I **Big Data and its Explosion in Organizations:** Challenges of Data Explosion, CEO's Perspective, Cultural Changes and Strategies for Cultural Transformation, Practising Managers, Practitioner's Perspectives, Formulating the Data Management Strategy **Basics of Big Data:** History of Big Data, Types of Big Data: Structured, Unstructured and Semi-structured Data, Vs of Big Data, Why Big Data Needs Analysis, Creating Values for Businesses using big data, Types of Big Data Analytics, Steps for Big Data Analytics (BDA), Role of Statistics in BDA, Types of Statistical Analysis, Role of Computer Science in BDA.	**6**
Module II **Converging Technologies:** Growth and Evolution of Disruptive Technologies, Internet of Things (IoT), Digital Reality Technologies: AR,VR and MR, Cloud, Big Data Storage Platforms (Apache Hadoop – HDFS), CEPH, Big Data on Cloud, Big	**6**

Data Analytical Tools, BigData Visualization Tools, Characteristics of Big Data Tools.	
Module III **Basics of Big Data Architecture (BDA):** Basic Components of a Big Data Architecture (BDA), Types of Big Data Architecture (BDA): Lambda Architecture, Kappa Architecture, Microservices Architecture, Zeta Architecture, IoT Architecture, Challenges of BDA, Benefits of BDA, Successful BDA Implementations.	**6**
Module IV **Big Data Privacy, Security and Ethical Concerns:** Privacy issues, Ensuring Big Data Privacy at Various Stages, Privacy Preserving Data Publishing (PPDP), Data Anonymization, Data Protection: Roles and Responsibilities, Challenges to Securing of Big Data, Ethical Issues and Principles of Big Data Ethics.	**6**
Module V **People Component of BDA:** People as a Prime Component of BDA, Role of a Data Analyst, Business Analyst, Data Engineer/Data Architect, Big Data Engineer, Data Scientist, Data Scientist vs Data Manager, Machine Learning (ML) Engineer **Quality Traits:** Personality, Professional Quality Traits **Applications of Big Data Analytics:** Finance Domain, Insurance Sector, HR Domain, Supply Chain Domain, Healthcare Sector, Services Industry.	**6**

TEXT BOOKS:

1. Big Data Analytics Using Artificial Intelligence Technologies: Transforming Organizations, by Rinku Dixit and Shailee Choudhary, Wiley Publishers.

REFERENCE BOOKS:

1. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses by Michele Chambers, AmbigaDhiraj, and Michael Minelli
2. Big Data, Black Book, Dreamtech Press

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1	2	3	1	2	2	3	2
CO2	3	3	3	1	3	1	1	1	1	2	2	2	2	2	2
CO3	3	3	3	3	3	1	2	2	2	1	1	2	2	3	2
CO4	3	3	3	1	3	1	1	1	1	1	1	2	2	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	2	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1, CO2, CO3, CO4	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2-CO5	CD1, CD9
CD3	Seminars	CO5	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO5	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO1-CO4	CD1, CD2
CD6	Industrial/Guest Lectures	CO5	
CD7	Industrial Visits/In-plant Training	CO5	
CD8	Self- learning such as use of NPTEL Materials and Internets	CO1-CO4	
CD9	Simulation	CO5	

ANNEXURE C
HIGH PERFORMANCE COMPUTING

SEMESTER VII/VIII

Course Code : **CN441**
Course Title : **MASSIVELY PARALLEL MODELS OF COMPUTATION**
Pre-requisite(s) :
Co- requisite(s) : **Massively Parallel Models of Computation Lab**
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Introduce programming paradigms for parallel computers and hardware and software used in it.
B.	Explain several programming platforms.
C.	Learn basic techniques of parallel algorithm development and different parallel communication operations.
D.	Address the modeling, analysis, and measurement of program performance.
E.	Describe, implement, and use parallel programming.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understanding of parallel hardware constructs, including instruction-level parallelism.
CO2	Understand the implicit and explicit parallel platform.
CO3	Decompose a given problem into many sub-problems using different decomposition techniques.
CO4	Use different performance metrics for analysis of parallel algorithms.
CO5	Use message passing library for communication among processes running on a parallel platform.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction**: Why parallel computing? Motivating and Scope of Parallel Computing **Parallel Hardware and Parallel Software:** Von Neumann architecture, Processes, multitasking, and threads, Modifications to the von Neumann Model, Parallel Hardware, Parallel Software, Input and Output, Performance, Parallel Program Design.	**10**
Module 2 **Parallel Programming Platforms:** Implicit Parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines,	**10**

Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.	
Module 3 **Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models. **Basic Communication Operations:** One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.	**10**
Module 4 **Analytical Modeling of Parallel Programs:** Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs.	**10**
Module 5 **Programming Using the Message-Passing Paradigm:** Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations. **MPI:** Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.	**10**

TEXT BOOKS:

1. A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to Parallel Computing. 2nd Ed., Pearson, 2011.
2. Peter S Pacheco, An Introduction to Parallel Programming, Morgan Kaufmann, 2011.
3. Joseph Ja'Ja', An introduction to parallel algorithms, 1st Edition, Addison-Wesley, 1992.

REFERENCE BOOKS:

1. V. Rajaraman and C. Siva Ram Murthy, Parallel Computers Architecture and Programming, PHI Learning Pvt. Ltd., 2012.
2. J. L. Hennessy and DA Patterson, Computer Architecture: A Quantitative Approach, 4th Ed., Morgan Kaufmann/Els India, 2006.
3. M. J. Quinn, Parallel Computing: Theory and Practice, Tata McGraw Hill, 2002.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	2	2	1	1	1	2	2	2	3	2	3
CO2	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3
CO4	3	3	2	3	3	1	1	1	1	2	3	3	3	2	3
CO5	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD5, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD8
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN442**
Course Title	**: MASSIVELY PARALLEL MODEL OF COMPUTATION LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 2 L:0 T:0	**P: 4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VII/ 4**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Describe the benefits and applications of parallel computing.
B.	Explain architectures of multicore CPU, GPUs, and HPC clusters, including the key concepts in parallel computer architectures, e.g. shared memory system, distributed system, NUMA and cache coherence, interconnection.
C.	Understand principles for parallel and concurrent program design, e.g. decomposition of works, task and data parallelism, processor mapping, mutual exclusion, and locks.
D.	Write programs that effectively use parallel collections to achieve performance.
E.	Use large-scale parallel machines to solve problems as well as discuss the issues related to their construction and use.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand about task and data parallel programs.
CO2	Express common algorithms in a functional style and solve them in parallel.
CO3	Analyze a problem, identify, formulate, and use the appropriate computing and engineering requirements to obtain its solution.
CO4	Write parallel program using OpenMP, CUDA, MPI programming models.
CO5	Perform analysis and optimization of parallel program.

Syllabus

List of Programs as Assignments:

1. Write a program that uses MPI and has each MPI process print 'Hello world from process i of n' using the rank in MPI_COMM_WORLD for i and the size of MPI_ COMM_ WORLD for n.
2. Write a parallel program to print any input message supplied by user.
3. Write a parallel program to add two one dimensional arrays of size 'n'.
4. Write a parallel program to add two matrices of order n * n.
5. Write a parallel program to multiply two matrices.
6. Write a parallel program to multiply a matrix of order n x n by a vector of size n.
7. Write a parallel Program to count the no. of vowels in a text.
8. Write a parallel program to find the largest element of n elements.
9. Write a parallel program to count no. of characters, words and lines in a file.
10. Write a parallel program to find factorial value of an integer.

11. Write a parallel program to find the transpose of a given Matrix.
12. Write a parallel program to implement ring topology.
13. Write a parallel program to find the largest and the second largest from a list of elements considering minimum no. of comparisons.
14. Write a parallel program to sort n elements, using any sorting technique.
15. Write a parallel program to solve a set of linear equations using gauss elimination method.
16. Write a parallel program to find the inverse of a given matrix of n*n order.
17. Write a parallel program to find minimal path (minimal cost) in an undirected graph.
18. Write a parallel program to find roots of an equation using N-R method.

TEXT BOOKS:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, Introduction to Parallel Computing (2nd Edition).
2. John Cheng, Max Grossman, and Ty McKercher, Professional CUDA C Programming, 1st Edition 2014.

REFERENCE BOOKS:

1. Barbara Chapman, Gabriele Jost, and Ruud van der Pas, Using OpenMP: Portable Shared Memory Parallel Programming, 2007.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (Pos)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	1	1	1	1	1	1	1	2	1	2	2	1	1	1
CO2	2	3	3	2	2	1	2	1	1	1	2	2	3	1	2
CO3	2	3	3	2	2	1	2	1	1	1	2	2	3	1	2
CO4	2	3	3	2	2	1	2	1	1	1	2	2	3	1	2
CO5	3	3	3	3	3	2	1	1	2	2	2	2	3	1	2

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD6, CD7
CD3	Seminars	CO3	CDl, CD2, CD3
CD4	Mini Projects/Projects	CO4	CDl, CD3, CD6, CD7
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD7
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN439**
Course Title : **ADVANCED COMPUTER ARCHITECTURE**
Pre-requisite(s) : **Computer Fundamental & Digital Logic Design**
Co- requisite(s) :
Credits:4 L:3 T:1 P:0
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VII/4**
Branch: Bachelor of Computer Applications

Course Objectives
This course enables the students to:

A.	Provide knowledge of Computer Architecture.
B.	Employ knowledge of various Digital Logic Circuits, Data Representation, Register and Processor level Design and Instruction Set architecture
C.	Develop the logical ability to Determine which hardware blocks and control lines are used for specific instructions.
D.	Understand memory organization, I/O organization and its impact on computer cost/performance.
E.	Know merits and pitfalls in computer performance measurements.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Describe the merits and pitfalls in computer performance measurements and analyze the impact of instruction set architecture on cost-performance of computer design.
CO2	Explain Digital Logic Circuits, Data Representation, Register and Processor level Design and Instruction Set architecture.
CO3	Solve problems related to computer arithmetic and determine which hardware blocks and control lines are used for specific instructions.
CO4	Design a pipeline for consistent execution of instructions with minimum hazards.
CO5	Explain memory organization, I/O organization and its impact on computer cost/performance.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 **Introduction Digital Logic Design**: Axioms and laws of Boolean algebra, Reduction of Boolean expressions, conversion between canonical forms, Karnaugh map (4 variable), Half Adder, Full Adder, Parallel Parity Bit Generator, Checker Circuit, Decoder, Encoder, Multiplexer, RAM, ROM, Memory Organization, Sequential Circuits, State transistors, Flip-flop, RS, JK, D-Latch, Masterslave.	**10**
Module 2 **Instruction Set Architecture Memory Locations and Addresses**: Byte Addressability, Big-Endian and Little-Endian Assignments, Word Alignment,	**10**

Instructions and Instruction Sequencing, Addressing Modes, Assembly Language, Subroutines, Additional Instructions, dealing with 32-Bit Immediate Values.	
Module 3 **Basic Processing Unit & Pipelining** Basic Processing Unit**:** Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control, CISC Style Processors. **Pipelining:** Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation.	**10**
Module 4: **Memory Organization** Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories, Performance Considerations, Virtual Memory, Memory Management Requirements, Secondary Storage.	**10**
Module 5: **Input Output: Basic Input Output**: Accessing I/O Devices, Interrupts, Input Output Organization: Bus Structure, Bus Operation, Arbitration, Interface, Interconnection Standards. **Parallel Processing:** Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Message-Passing Multicomputers, Parallel Programming for Multiprocessors, Performance Modelling.	**10**

TEXT BOOKS:

1. Hamacher Carl, et. al, "Computer Organization and Embedded Systems", 6th Edition, Tata McGraw Hill, New Delhi.
2. Mano M. Morris, "Computer System Architecture", Revised 3rd Edition, Pearson Education.

REFERENCE BOOKS:

1. Patterson David A., "Computer Organization and Design: The Hardware Software / Interface", 5th Edition.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	3	2	3	2	1	1	2	1	2	3	3	2
CO2	3	3	2	3	3	3	2	1	1	1	1	2	3	2	2
CO3	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO4	3	3	3	3	2	2	1	1	1	2	1	2	3	3	3
CO5	3	3	3	3	3	3	3	1	1	2	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD6
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD6
CD3	Seminars	CO3	CD1, CD2, CD3,
CD4	Mini Projects/Projects	CO4	CD1, CD3,
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD4, CD5
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN443**
Course Title : **HIGH PERFORMANCE CLUSTER COMPUTING**
Pre-requisite(s) :
Co- requisite(s) :
Credits:3 L: 3 T: 0 P: 0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VII/ VIII / 4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Gain a solid understanding of the principles and concepts underlying high-performance cluster computing, including parallel processing, fault tolerance, and scalability.
B.	Explore the architecture and components of high-performance clusters, including hardware, network topologies, and cluster management software.
C.	Learn parallel and distributed programming models, such as MPI and frameworks like Hadoop and Spark, to effectively harness the computing power of clusters.
D.	Develop practical skills in deploying and managing high-performance clusters, including configuration, installation, resource allocation, and job scheduling.
E.	Discover performance optimization techniques specific to cluster computing, such as profiling, load balancing, and parallel algorithm optimization, to maximize the efficiency and speed of cluster-based computations.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Demonstrate a comprehensive understanding of the principles and concepts underlying high-performance cluster computing.
CO2	Design and implement parallel and distributed algorithms to leverage the computing power of clusters effectively.
CO3	Configure, deploy, and manage high-performance clusters, including hardware, software, and networking components.
CO4	Utilize parallel programming models and frameworks to develop efficient cluster-based applications.
CO5	Analyze and optimize the performance of cluster-based computations through techniques such as load balancing, task scheduling, and resource allocation.

Syllabus

MODULE	**(NO. OF LECTURE HOURS)**
Module 1 What is cluster computing? Approach to parallel computing, how to achieve low-cost parallel computing through clusters, definition, and architecture of a cluster, what is the functionality a cluster can offer? Categories of clusters.	**8**
Module 2	

Cluster middleware: an introduction, levels and layers of single system image (SSI), cluster middleware design objectives, resource management and scheduling.	**8**
Module 3 Cluster programming environment and tools, threads, message passing system, PVM, distributed shared memory, parallel debugger, performance analysis tools, cluster administrative tools.	**8**
Module 4 Networking, protocols and I/O for clusters, networks and interconnection/ switching devices, design issues in interconnection networking/ switching, HiPPI, ATM, Myrinet, memory channel, Gigabit Ethernet.	**8**
Module 5 Cluster technology for high availability: Highly available clusters, highly available parallel computing, types of failure and errors, cluster architecture and configurations for high availability, faults, and error detection.	**8**

TEXT BOOKS:

1. C.S.R. Prabhu, Grid and Cluster Computing, PHI Learning, New Delhi.

REFERENCE BOOKS:

1. Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Prentice Hall PTR, 2007
2. Richard S. Morrison, Cluster Computing Architectures, Operating Systems, Parallel Processing & Programming Languages.

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Limited coverage of containerization and orchestration technologies for cluster deployment and management.
2. Inadequate exposure to distributed storage systems and data processing frameworks for handling large-scale data workloads in industry.

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)											Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	1	2	2	3	1	2	2	3	1	2	2	3	1
CO2	2	3	2	3	2	3	1	3	1	3	2	3	1	3	2
CO3	1	3	3	4	2	3	3	4	2	2	3	4	2	3	2
CO4	4	4	3	3	3	4	3	3	3	4	3	3	3	4	3
CO5	3	3	2	2	4	3	2	2	4	3	2	1	4	3	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2
CD2	Tutorials/Assignments	CO2	CD1, CD2
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD4
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD3
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN445**
Course Title : **GRID COMPUTING**
Pre-requisite(s) :
Co- requisite(s) : **Grid Computing Lab**
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the elements of distributed computing and core aspects of Grid computing.
B.	Understand the concepts and aspects of virtualization and application of virtualizationtechnologies in Grid computing environment.
C.	Understand the architecture and concept of Grid.
D.	Understand the key security, compliance, and confidentiality challenges in Grid computing.
E.	Understand the commonly used Grid programming platforms, tools, and simulator.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Recall the various aspects of Grid computing and distributed computing
CO2	Understand the specifics of virtualization and Grid computing architectures.
CO3	Develop and deploy Grid application.
CO4	Evaluate the security and operational aspects in Grid system design, identify anddeploy appropriate design choices when solving real-world Grid computing problems.
CO5	Identify and deploy appropriate design choices when solving real-world Grid computing problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction:** Motivation; Definitions of Grid Computing; Evolution of the Grid; Differences with similar efforts (Meta, cluster, heterogeneous, Internet); Examples of usage; Research possibilities / scope in Grid Computing; Thrust areas. **High Performance computing:** PACX-MPI, MPI-Connect, P-MPI; I-WAY experiment.	**10**
Module 2 **Earliest Grid Tools / Projects:** Condor Part 1, Part 2; Globus Part 1, Part 2; Nimrod.	**8**
Module 3	**7**

Grid Basics - Technologies / Challenges: Security - Different models: SSL, Kerberos, SASL, GSI, Others; Information Services: NWS.	
Module 4 **HPC and Grids:** Scheduling HPC applications in Grids: AppLeS, Scheduling Parameter sweep applications, Metascheduling Part1, Part2; Grid RPC mechanisms - Part1, Part2; Rescheduling; Computational Steering, Scientific visualization of Grid applications; Grid Applications - Everywhere and Cactus experiments; Data management: Data distribution, Redistribution, Data cache maintenance.	**10**
Module 5 **Recent Efforts:** Grid economy; Grid simulation - SimGrid, GridSim, MicroGrid; Grid standards and forums - OGSA, GGF.	**5**

TEXT BOOKS:

1. **Ian Foster, Carl Kesselman**; The Grid: Blueprint for a New Computing Infrastructure; Morgan Kaufmann Publishers; 2nd edition, 2003.
2. **Francine Berman, Geoffrey Fox, Tony Hey**; Grid Computing: Making the Global Infrastructure a Reality; John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. **Jarek Nabrzyski, Jennifer M. Schopf, Jon Weglarz**; Grid Resource Management: State of the Art and Future Trends; Kluwer Academic Publishers, 2003.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	2	2	2
CO2	3	3	3	1	3	1	1	1				2	2	3	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN447**
Course Title : **INTRODUCTION TO QUANTUM COMPUTING**
Pre-requisite(s) :
Co- requisite(s) :
Credits: 3 L:3 T:0 P:0
Class schedule per week : **03**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the supremacy of Quantum computer over classical computer.
B.	Understand the concepts and aspects of quantum Entanglement.
C.	Understand the concept of Quantum Teleportation.
D.	Understand the concept of quantum cryptography.
E.	Understand the commonly used Quantum programming platforms, tools, and simulator.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand the supremacy of Quantum computer.
CO2	Recall the various aspects of Quantum computing Platform.
CO3	Understand the specifics of Quantum Computing Parallelism.
CO4	Develop and deploy Quantum Computing application.
CO5	Evaluate the concept of Quantum cryptography.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Quantum Mechanical Preliminaries:** Origin of Quantum Mechanisms and its Scope. Two Fundamental Ideas of Quantum Mechanics': Idea of Discreteness, Idea of Wave Particle Duality. Uncertainty Relations and Results ensuing There from Mathematical Preliminaries: Introduction, Operator Concept: Linear operators, Hermitian operator and Eigenvalue of problem, Important Theorems on Operators Basic Postulates of Quantum mechanisms. Dirac's Bra-ket notations: Eigenstates and Eigen values of operators. Principle of Superposition of states and Interference of Transmission Amplitudes Measurement in Quantum Mechanics. Matrix representation of operators and Eigen states.	**8**
Module 2	

Quantum Model of Computation: Classical Bit, Quantum Bits, Mathematical Foundation of Quantum Bit, Dirac Notation for Quantum Bit, Matrix Representation of Superposition States of Qubit,The Bloch Sphere, Myth About a Single Qubit, Quantum Measurement Postulate, Bipartite System and Multipartite System.	**8**
Module –3 **Quantum Circuit Model:** Turing Machine, Quantum Turing Machine, Quantum Circuit, Introduction of Quantum Gates: Single Qubit Quantum Gates, Quantum NOT Gate, Quantum Z Gate, Quantum Y Gate, Quantum Hadamard Gate, Phase Gate. T Gate, Relationship of Single Qubit Quantum Gates and Pauli Matrices, Representation of Single Qubit Quantum Gates on Bloch Sphere, Implementation of Single Quantum Gate Using Python Programming Language, Overview of Qiskit.	**8**
Module 4 **Quantum Supremacy** Mathematical Background, Visual Representation of Multipartite State, Multiple Qubit, Quantum Gates - Controlled Not Gate: SWAP Gate, Controlled Z Gate, Toffoli Gate. Matrix Representation of Quantum Circuit, Half Adder, ORACLE, No Cloning Theorem, Quantum Parallelism.	**8**
Module 5 **Application of Quantum Computing** Simple Quantum Algorithms- Shor's Algorithm, Quantum Fourier Transformation, Quantum Search Algorithms. Physical Realization of Quantum Computers, Bell State, Quantum Teleportation.	**8**

TEXT BOOKS:

1. **Michael A. Nielsen, Isaac L. Chuang;** Quantum Computation and Quantum Information; Cambridge University Press; 10^{th} edition, 2010.

REFERENCE BOOKS:

1. **Nikhil Ranjan Roy;** Introduction to Quantum Mechanics; Vikash Publishing House Pvt Ltd, Ist Edition, 2015.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	2	2	2
CO2	3	3	3	1	3	1	1	1				2	2	3	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN444**
Course Title : **CLUSTER COMPUTING LAB**
Pre-requisite(s):
Credits: 2 L:0 T:0 P: 4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VIII/ 4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Develop practical skills in setting up and configuring a high-performance cluster environment for distributed computing tasks.
B.	Gain hands-on experience in utilizing cluster computing frameworks like Apache Spark for distributed data processing and analytics.
C.	Learn to design and implement parallel algorithms using cluster computing techniques to solve computationally intensive problems efficiently.
D.	Understand load balancing and task scheduling strategies to optimize resource utilization and improve overall cluster performance.
E.	Enhance proficiency in performance analysis, profiling, and optimization techniques for cluster-based applications.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Demonstrate proficiency in setting up and configuring a high-performance cluster environment for efficient distributed computing tasks.
CO2	Apply cluster computing frameworks like Apache Spark to perform distributed data processing and analytics tasks effectively.
CO3	Design and implement parallel algorithms using cluster computing techniques to solve complex computational problems with improved performance.
CO4	Evaluate and optimize the performance of cluster-based applications through performance analysis, profiling, and tuning techniques.
CO5	Develop practical skills in load balancing, task scheduling, and resource management for optimal utilization of cluster resources.

Syllabus

List of Programs as Assignments:
1. Installing and Configuring PySpark, Apply any standalone program.
2. Use python library Charm4py for cluster computing
3. Use Dask (library for parallel computing in Python)
   2.1 Create Random array
   2.2 Create Random Data
   2.3 Create Random Dataframe
   2.4 Create simple functions
   2.5 Parallelize Normal Python code
4. Study and use function dispy (Distributed and Parallel Computing)
5. Parallel Python and for parallel execution of python code on SMP (systems with multiple processors or cores) and clusters (computers connected via network).

6. Use of function mpi4py
    6.1 Create a venv and install scipy
    6.2 Install and test mpi4py
    6.3 Parallelizing the map method

TEXT BOOKS:

1. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide Big Data Processing Made Simple, O'Reilly Media, Inc.
2. Francesco Pierfederici, Distributed Computing with Python, PACKT publishing.
3. C.S.R. Prabhu, Grid and Cluster Computing, PHI Learning, New Delhi.

REFERENCE BOOKS:

1. Rajkumar Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Prentice Hall PTR, 2007
2. Richard S. Morrison, Cluster Computing Architectures, Operating Systems, Parallel Processing & Programming Languages.
3. https://wiki.python.org/moin/ParallelProcessing

Gaps in the Syllabus (to meet Industry/Profession requirements)

1. Cloud Computing Integration
2. Big Data Processing: Incorporating a component on big data processing frameworks like Apache Hadoop or Apache Flink

POs met through Gaps in the Syllabus: 1, 3, 4, 12

Topics beyond syllabus/Advanced topics/Design

1. Containerization and Orchestration: Introducing containerization technologies like Docker and container orchestration platforms like Kubernetes to enable students to deploy and manage cluster computing applications in a containerized environment.
2. Distributed Machine Learning: Exploring distributed machine learning frameworks such as TensorFlow or PyTorch in the context of cluster computing.

POs met through Topics beyond syllabus/Advanced topics/Design- 1, 2, 4, 7

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	3	1	2	3	1	2	3	1	2	3	1	3	3	1
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	2	2	3	2	2	1	2	2	1	3	2	1	2	2	1
CO4	1	2	3	3	2	3	1	2	3	1	2	3	1	2	3
CO5	2	1	3	2	1	3	2	1	3	2	1	3	2	1	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD3, CD4, CD5
CD2	Tutorials/Assignments	CO2	CD2, CD5
CD3	Seminars	CO3	CD3, CD4, CD5
CD4	Mini Projects/Projects	CO4	CD3, CD4, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD3, CD4
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code : **CN446**
Course Title : **GRID COMPUTING LAB**
Pre-requisite(s) :
Co- requisite(s) : **Grid Computing**
Credits: 2 L:0 T:0 P:4
Class schedule per week : **04**
Class : **BCA**
Semester / Level : **VIII/4**
Branch : **Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the elements of Grid computing Toolkit.
B.	Understand the concepts of virtualization in Grid environment.
C.	Understand the architecture Grid Computing Toolkit.
D.	Understand the key security challenges in Grid Toolkit.
E.	Understand the commonly used Grid simulator.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Recall the various aspects of Grid computing.
CO2	Understand the concepts of virtualization in Grid environment.
CO3	Understand the specifics of Grid computing architectures.
CO4	Develop and deploy Grid Toolkit.
CO5	Deploy appropriate design choices when solving real-world Grid computing problems.

SYLLABUS

List of Programs as Assignments:
Use Globus Toolkit or equivalent and do the following:

1. Develop a new Web Service for Calculator.
2. Develop new OGSA-compliant Web Service.
3. Using Apache Axis develop a Grid Service.
4. Develop applications using Java or C++ Grid APIs.
5. Develop secured applications using basic security mechanisms available in Globus
6. Toolkit.
7. Develop a Grid portal, where user can submit a job and get the result.
8. Find procedure to run the virtual machine of different configuration.
9. Check how many virtual machines can be utilized at a particular time.
10. Find procedure to attach virtual block to the virtual machine and check whether it
11. holds the data even after the release of the virtual machine.
12. Install a C++ compiler in the virtual machine and execute a sample program.
13. Show the virtual machine migration based on the certain condition from one node to the other.
14. Find procedure to install storage controller and interact with it.
15. Find procedure to set up the one node Hadoop cluster.
16. Mount the one node Hadoop cluster using FUSE.

17. Write a program to use the API's of Hadoop to interact with it.
18. Write a wordcount program to demonstrate the use of Map and ReducetasksInstall.

TEXT BOOKS:

1. **Ian Foster, Carl Kesselman**; The Grid: Blueprint for a New Computing Infrastructure (2nd edition)**;** Morgan Kaufmann Publishers; 2nd edition, 2003.
2. **Francine Berman, Geoffrey Fox, Tony Hey**; Grid Computing: Making the Global Infrastructure a Reality; John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Jarek Nabrzyski, Jennifer M. Schopf, Jon Weglarz; Grid Resource Management: State of the Art and Future Trends; Kluwer Academic Publishers, 2003.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	1	3	1	1	1				2	2	2	2
CO2	3	3	3	1	3	1	1	1				2	2	3	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN448**
Course Title	**: QUANTUM COMPUTING LAB**
Pre-requisite(s)	**:**
Co- requisite(s)	**: Introduction to Quantum Computing**
Credits: 2 L:0 T:0	**P:4**
Class schedule per week	**: 04**
Class	**: BCA**
Semester / Level	**: VIII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Understand the elements of Quantum computing Toolkit.
B.	Understand the concepts of Quantum Supremacy.
C.	Understand the architecture of Quantum Computing Toolkit.
D.	Understand the application of Quantum Computing.
E.	Understand the commonly used Quantum Computing simulator.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the concepts of Quantum Supremacy.
CO2	Recall the various aspects of Quantum computing.
CO3	Understand the concept of Quantum Computing Algorithms.
CO4	Develop and deploy Quantum Computing Application on Qiskit.
CO5	Deploy appropriate design choices when solving real-world Quantum computing problems.

SYLLABUS

List of Programs as Assignments:

Use IBM Qiskit. or equivalent and do the following using Python Programming Language:

1. Write a program to display "Welcome" Message.
2. Write a program to obtain maximum between two numbers.
3. Write a program to obtain minimum between two numbers
4. Write a program to obtain factorial of a positive number.
5. Write a program to generate the first n natural numbers
6. Write a program to check whether a number is even number or not.
7. Write a program to generate multiplication table of a user defined number.
8. Write a program to check whether an input number is positive number or not.
9. Write a program to obtain area of a rectangle. Take length and breadth of rectangle from user.
10. Write a program to obtain area of a circle. Take radius of circle from user.

TEXT BOOKS:

1. Michael A. Nielsen, Isaac L. Chuang; Quantum Computation and Quantum Information ; Cambridge University Press ; 10th edition, 2010.

REFERENCE BOOKS:
1. James L. Weaver, Fank J. Harkins; Qiskit Pocket Guide: Quantum Development with Qiskit; O'Reilly, Ist Edition, 2022.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Second Quiz	10
Viva voce	20
Day to day performance	30
Exam Evaluation performance	30

Indirect Assessment
1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1				2	2	2	2
CO2	3	3	3	1	3	1	1	1				2	2	3	2
CO3	3	3	3	3	3	1	2	2		1	1	2	2	3	2
CO4	3	3	3	1	3		1	1		1	1	2	3	2	3
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	2	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD7, CD 8
CD2	Tutorials/Assignments	CO2	CD1, CD9
CD3	Seminars	CO3	CD1, CD2, CD3
CD4	Mini Projects/Projects	CO4	CD1, CD2

CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN449**
Course Title	**: PARALLEL ALGORITHM AND COMPUTATION**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits:3 L: 3 T:0	**P: 0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: VIII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives

This course enables the students to:

A.	Learn of basics of parallel computing.
B.	Learn about the applications of the parallel computing in today's world.
C.	Learn basic techniques of parallel algorithms.
D.	Learn SIMD and MIMD algorithms.
E.	Learn about parallel algorithms for multiprocessors.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the concept of Parallel Computing.
CO2	Have knowledge on Application of Parallel processing and Data Parallelism.
CO3	Understand the Performance Evaluation of Parallel Computers.
CO4	Learn sorting and searching using parallel algorithm.
CO5	Test different parallel algorithms.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 Definition Introduction to Parallel Computing, Basic Concepts about Program /Process / Thread Concurrent Function, Parallel Execution. Parallel Processing Terminology- Contrasting Pipelining and Data Parallelism, Control Parallelism, Scalability, Control-Parallel Approach, Data-Parallel Approach with I/O.	**8**
Module 2 Granularity Potential of Parallelism, Level of Parallel Processing, Applications of Parallel Processing, Scientific Applications, Database Query conserving applications, AI applications.	**8**
Module 3 PRAM Algorithm, Message Passing Programming, Shared memory, Message Passing Libraries, Data Parallel Programming, Parallel Reduction, Prefix Sums, List Ranking, Preorder Tree Traversal, Merging two sorted lists.	**8**

Module 4 2D Mesh SIMD Model - Parallel Algorithms for Reduction - Prefix Computation - Selection - Odd-Even Merge Sorting - Matrix Multiplication, Hypercube SIMD Model - Parallel Algorithms for Selection- Odd-Even Merge Sort.	**8**
Module 5 Elementary Parallel Algorithm: Classifying MIMD Algorithm, Reduction. Matrix Multiplication: Sequential Matrix Multiplication, Algorithms for Processor Array, Algorithms for Multiprocessors.	**8**

TEXT BOOKS:

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. V Rajaraman, C Siva Ram Murthy, "Parallel computers- Architecture and Programming ", PHI learning, 2016.

REFERENCE BOOKS:

1. M Sasikumar, Dinesh Shikhare and P Ravi Prakash, " Introduction to Parallel Processing", PHI learning, 2013.
2. H.Attiya & J. Welch- Distributed Computing- Fundamentals, Simulations and Advanced Topics, 2nd Edn., Wiley India Publication, New Delhi, 2006.
3. S.G. Akl, "The Design and Analysis of Parallel Algorithms", PHI, 1989.

Gaps in the Syllabus (to meet Industry/Profession requirements):

1. Classification based grain size and instruction level parallelism
2. Network design issues of interconnected network

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

<u>Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure</u>

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	2	3	1	1	2	2	3	3	2	3	1	1	2
CO2	3	2	2	3	2	2	2	2	3	2	3	3	2	3	3
CO3	3	3	2	2	1	1	2	2	2	2	2	3	2	3	3
CO4	3	3	2	2	2	2	3	3	2	2	3	3	1	3	3
CO5	3	3	3	2	2	2	2	3	3	3	3	3	2	3	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD3
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5
CD3	Seminars	CO3	CD1, CD2, CD3, CD5
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD3, CD5
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD3, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		

Course Code	**: CN451**
Course Title	**: HIGH-PERFORMANCE BIG DATA COMPUTING**
Pre-requisite(s)	**:**
Co- requisite(s)	**:**
Credits: 3 L: 3 T: 0	**P: 0**
Class schedule per week	**: 03**
Class	**: BCA**
Semester / Level	**: VIII/4**
Branch	**: Bachelor of Computer Applications**

Course Objectives
This course enables the students to:

A.	Understand the principles of High-performance Computing.
B.	Understand the principles of parallel computing.
C.	Apply parallel programming models to real-world problems.
D.	Evaluate the performance of parallel programs.
E.	Select and use appropriate HPC systems and software.

Course Outcomes
After the completion of this course, students will be able to:

CO1	Understand the principles, challenges, and application of HPC.
CO2	Apply the different parallel programming models.
CO3	Design algorithms for parallel computation.
CO4	Evaluate the performance of parallel programs.
CO5	Use the different types of HPC software.

Syllabus

MODULE	(NO. OF LECTURE HOURS)
Module 1 **Introduction to HPC:** history, applications, and Challenges **Parallel architectures:** superscalar architectures, multi-core, multi-threaded, server, and cloud.	8
Module 2 **Parallel Programming Models:** MPI, OpenMP, and CUDA **Algorithms for parallel computation:** load balancing, data partitioning, and communication.	8
Module 3 **Fundamental design issues in HPC:** Load balancing, scheduling, synchronization, and resource management; Operating systems for scalable HPC **Performance analysis of parallel algorithms:** different metrics, such as execution time, speedup, and efficiency.	8

Module 4 **HPC systems and architectures:** supercomputers, clusters, and cloud computing platforms.	**8**
Module 5 **HPC software:** different types of HPC software, such as compilers, libraries, and tools	**8**

TEXT BOOKS:

1. Georg Hager Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press.
2. R. Buyya, High Performance Cluster Computing: Architectures and Systems, Volume 1, Pearson Education, 2008.
3. D. Janakiram, Grid Computing, Tata McGraw-Hill, 2005.
4. Vipin Kumar , Ananth Grama , Anshul Gupta , George Karypis. Introduction to Parallel Computing (2nd ed.). Pearson India . 2003.

REFERENCE BOOKS:

1. B. Sosinsky, Cloud Computing Bible, Wiley, 2011.
2. B. Wilkinson, Grid Computing: Techniques and Applications, CRC Press, 2009.
3. R. Buyya, C. Vecchiola and S. T. Selvi, Mastering Cloud Computing Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

Gaps in the Syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment Tools & Evaluation Procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher’s Assessment	5
End Semester Examination	50

Indirect Assessment

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Mapping between COs and Program Outcomes

Course outcome	Program Outcomes (POs)												Program Specific Outcomes		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	3	3	2	2	2	1	1	1	2	2	2	3	2	3
CO2	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3
CO3	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3
CO4	3	3	2	3	3	1	1	1	1	2	3	3	3	2	3
CO5	3	3	3	3	3	2	1	1	1	2	3	3	3	2	3

Correlation Levels 1, 2 or 3 as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery Methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of Boards/LCD Projectors	CO1	CD1, CD2, CD5, CD8
CD2	Tutorials/Assignments	CO2	CD1, CD2, CD5, CD8
CD3	Seminars	CO3	CD1, CD2, CD5, CD8
CD4	Mini Projects/Projects	CO4	CD1, CD2, CD5, CD8
CD5	Laboratory Experiments/Teaching Aids	CO5	CD1, CD2, CD5, CD9
CD6	Industrial/Guest Lectures		
CD7	Industrial Visits/In-plant Training		
CD8	Self- learning such as use of NPTEL Materials and Internets		
CD9	Simulation		