SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Academic Program Guide

for

Bachelor of Technology (Honors)

Computer Science and Engineering

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

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1. Vision and Mission of the School

Vision:

To be a leading Institution by imparting quality education, nurturing Innovation and entrepreneurial attitude to prepare globally competent technocrats.

Mission:

M1. To impart quality education in order to meet industry needs and achieve excellence in teaching-learning process.

M2. To create an ecosystem that promotes innovation for a sustainable future which leads to entrepreneurship culture.

M3. To collaborate with other academic institutes, research institutes and industries to provide state-of-the art latest technological learning.

2. Program Educational Objectives (PEOs)

PEO1. Graduates shall have the ability to apply knowledge across the disciplines and in emerging areas of Computer Science and Engineering for higher studies, research, employability, product development and handle the realistic problems.

PEO2. Graduates shall have good communication skills, possess ethical conduct, sense of responsibility to serve the society and protect the environment.

PEO3. Graduates shall possess academic excellence with high ethical values, soft skills, managerial skills, leadership qualities, knowledge of contemporary issues and understand the need for lifelong learning for a successful professional career.

PEO4. To imbibe in graduates the team-spirit and problem-solving skills so they can lead organizations they join in or initiate their own ventures.

PEO5. To disseminate the ability to analyze the requirements, understand the technical specifications and design the innovative solutions by applying the principles of computing.

3. Program Outcomes (POs):

PO1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **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.

PO5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The Engineer 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 professional engineering practice.

PO7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **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.

4. Program Duration and Eligibility

The duration of B.Tech program is four years, divided in eight semesters. The student seeking admission in B.TECH (HONS) CSE should have a minimum aggregate of 60% marks or must have secured 60% in Physics, Chemistry and Mathematics in 12th grade. He/She should have appeared in SEE for that admission year. The admission is based on merit.

5. Curriculum Components and Credits

The various courses prescribed for a program is categorized in terms of their functional objectives as follows:

Core Courses: Core courses are the foundation courses that cater to develop the breadth of computer science and engineering stream and also includes mathematics, basic science and engineering science courses. Core courses are compulsory and can be offered in any semester during the program tenure.

Program Electives / Specialization Courses: The technical courses apart from core courses are offered as electives to the students. These are the professional courses that are offered to students to cover the depth in a specified area of computer science for their employment, research or higher

studies. The student can choose a specialization track to enhance their skills in a particular area and to gain industry exposure.

Generic Electives: It is elective courses chosen from other departments and/or schools with an intention to seek exposure in other field of interest.

Ability & Skill Development Courses: These courses help students to perform a particular activity in a very experienced manner can be known as a skill. It improves the ability of an individual to solve a complex task or problem.

Project Based Learning / Projects: These are hands-on courses to apply the knowledge gained through program core / elective courses. It engages them in solving a real-world problem or answering a complex question. The students identify their team-mates and work on a unique project. The project can be suggested by faculty mentor or by students after getting due approval from faculty-in-charge. The projects are allotted to them at the start of the semester.

MOOC: Students are given a choice of technical and industry-oriented courses to get the knowledge of new technologies. They have an option of choosing the course from any online platforms like NPTEL / SWAYAM / Coursera / Udemy etc.

Credits

Components	Credits
Program Core	**70**
Program Electives (Discipline Specific Electives)	**52**
Generic Electives	**8**
Ability & Skill Development (Ability Enhancement Courses)	**8**
Ability & Skill Development (Skill Enhancement Courses)	**6**
Project Based Learning (PBL) / Projects / MOOCs	**48**
Total	**192**

Distribution of credits across all components

Sem	Program Core	Program Electives / Specialization	Generic Electives	Ability & Skill Development		Project Based Learning (PBL) / Projects / MOOCs	Total Credit
				Ability Enhancement Courses	Skill Enhancement Courses		
I	14	4	-	2	2	2	**24**
II	14	8	-	2	-	2	**26**
III	12	8	2	-	2	2	**26**
IV	11	8	2	-	2	2	**25**
V	11	8	2	2	-	2	**25**
VI	8	8	2	2	-	2	**22**
VII	-	8	-	-	-	12	**20**
VIII	-	-	-	-	-	24	**24**
Total	**70**	**52**	**8**	**8**	**6**	**48**	**192**

6. Assessment and Evaluation

The evaluation will be continuous and the weightage of various components is as given in tables specified for each type of course.

Program Core / Program Electives / Specialization / Ability & Skill Development Courses:

Theory Courses		**Lab Courses**	
Mid Semester Exam	30	Continuous Assessment	20
Quizzes / Assignments	05	End Semester Exam	30
Teachers Component	05		
Attendance	10		
End Semester Exam	50		
Total	**100**	**Total**	**50**

Project Based Learning / Summer Internship / MOOC:

Continuous Assessment	50
End Semester Exam	50
Total	**100**

Projects:

Minor Project		**Major Project**	
Continuous Assessment	100	Continuous Assessment	200
End Semester Exam	100	End Semester Exam	200
Total	**200**	**Total**	**400**

7. Grading System

The list of letter grades is given below:

Percentage	Letter Grade	Grade Point	Performance Indicator
90 – 100	O	10	Outstanding
80 – 89.9	A	9	Excellent
70 – 79.9	B	8	Good
60 – 69.9	C	7	Fair
50 – 59.9	D	6	Average
40 – 49.9	E	5	Satisfactory
0 – 39.9	F	0	Fail
	DB	0	Debarred
	AB	0	Absent
	WH	0	Withheld

Calculation of SGPA and CGPA

$$SGPA = \frac{\sum C_i G_i}{\sum C_i},$$

Where C_i is credit for each course and G_i is the grade point obtained by the student in that course

$$CGPA = \frac{\sum C_i S_i}{\sum C_i},$$

Where C_i is the total credits for each semester and S_i is the SGPA of that semester

8. Eligibility to Award the Degree

- Student shall be eligible for award of degree subject to passing all the semesters.
- Award of division shall be made only on completion of the program
    - First Division with Distinction – if CGPA is greater than or equal to 8.0
    - First Division – if CGPA is less than 8.0 and greater than or equal to 6.5
    - Second Division – if CGPA is less than 6.5 and greater than or equal to 5.0
- Merit list shall comprise of 10% of the program intake with maximum of 10 students who pass in first division and passing each semester in the first attempt only.

9. Rules for Attendance

The University expects its students to be regular in attending the classes. 75% attendance (of all held sessions – lectures, tutorials, labs, projects) is compulsory in a course to be eligible to appear for End Semester Examination. The students are also encouraged for participation in co-curricular activities and can do so in 25% cushion provided in the attendance requirements.

10. Program Scheme

B.TECH (HONS) CSE - FIRST SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B101	Environmental Studies and Disaster Management	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
UC20B102	Communication Skills	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
MA20B103	Engineering Mathematics – I	4	0	0	4	3	30	05	05	10	50	50	100	-	-	-	100
EE20B202	Basic Electrical and Electronics Engineering	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
ME20B105	Engineering Drawing	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B106	Programming Practice – I	0	0	4	2	-	-	-	-	-	-	-	-	20	30	50	50
Table – I	DSE – I	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
PB20B101	Project Based Learning – I	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			24												900

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - SECOND SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B202	Entrepreneurship Development	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
MA20B204	Engineering Mathematics – II	4	0	0	4	3	30	05	05	10	50	50	100	-	-	-	100
PY20B104	Engineering Physics	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS24B206	Logic for Computer Science	3	0	0	3	3	30	05	05	10	50	50	100	-	-	-	-
CS20B205	Programming Practice – II	0	0	4	2	-	-	-	-	-	-	-	-	20	30	50	50
Table – I	DSE – II	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table – I	DSE – III	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
PB20B201	Project Based Learning – II	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			25												900

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - THIRD SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B302	Quantitative Aptitude – I	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
CS20B301	Operating System	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B302	Data Structure and Algorithms	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B303	Java Programming	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – IV	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – V	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 2	Generic Electives – I				2	Refer Table 2											100
PB20B301	Project Based Learning – III	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			26												1050

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - FOURTH SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B402	Quantitative Aptitude – II	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
CS20B401	Object Oriented Analysis and Design	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B403	Database Management System	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS23B404	Computer Organization and Architecture	3	0	0	3	3	30	05	05	10	50	50	100	-	-	-	100
Table 1	DSE – VI	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – VII	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 2	Generic Electives – II				2	Refer Table 2											100
PB20B401	Project Based Learning – IV	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			25												1000

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - FIFTH SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B501	Introduction to Management and Leadership	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
CS20B501	Computer Networks	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B502	Theory of Computation	2	1	0	3	3	30	05	05	10	50	50	100	-	-	-	100
CS20B503	Analysis and Design of Algorithms	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – VIII	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – IX	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 2	Generic Electives – III				2	Refer Table 2											100
PB20B501	Project Based Learning – V	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			25												1000

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - SIXTH SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
UC20B601	Social and Professional Ethics	2	0	0	2	3	30	05	05	10	50	50	100	-	-	-	100
CS20B601	Software Engineering	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS23B602	Compiler Design	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – X	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – XI	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 2	Generic Electives – IV				2	Refer Table 2											100
PB20B601	Project Based Learning – VI	0	0	4	2	-	-	-	-	-	-	-	-	50	50	100	100
		Total			25												900

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - SEVENTH SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
		L	T	P			Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
							MSE	ASG	TA	ATTD	ToT						
Table 1	DSE – XII	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
Table 1	DSE – XIII	3	0	2	4	3	30	05	05	10	50	50	100	20	30	50	150
CS20B703	Summer Internship Project	0	0	8	4	-	-	-	-	-	-	-	-	50	50	100	100
CS20B704	Minor Project	0	0	16	8	-	-	-	-	-	-	-	-	100	100	200	200
		Total			20												600

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

B.TECH (HONS) CSE - EIGHTH SEMESTER wef 2023-24																	
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration	Weightage (Theory)							Weightage (Practical)			GT
							Internal Assessment (IA)					ESE	GT	CE^	ESE	ToT	
		L	T	P			MSE	ASG	TA	ATTD	ToT						
MO20B801	MOOC – I	0	0	8	4	-	-	-	-	-	-	-	-	50	50	100	100
MO20B802	MOOC – II	0	0	8	4	-	-	-	-	-	-	-	-	50	50	100	100
CS20B801	Major Project	0	0	32	16	-	-	-	-	-	-	-	-	200	200	400	400
		Total			24												600

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE- End Semester Exam, Tot -Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Total Credits = 191

Table-I (A)
List of Discipline Specific Electives (DSE)

Specialization Track – Artificial Intelligence

SN	DSE	Semester	Course Code	Course Name
1.	I	I	AI23B101	Foundation to Artificial Intelligence, Data Science and Machine Learning
2.	II	II	AI23B201	Data Analysis using Python
3.	III	II	CS20B108	Introduction to Computational Thinking
4.	IV	III	AI23B301	Probabilistic Modelling and Reasoning with Python
5.	V	III	AI23B302	R Programming for Data Science
6.	VI	IV	AI23B401	Machine Learning and Pattern Recognition
7.	VII	IV	AI23B402	Data Visualization and Story Telling
8.	VIII	V	AI23B501	Advance Machine Learning
9.	IX	V	AI23B502	Scala for Data Science
10.	X	VI	AI23B601	Deep Learning and Neural Network
11.	XI	VI	AI23B602	Advance Data Visualization
12.	XII	VII	AI23B701	Advance Deep Learning
13.	XIII	VII	AI23B702	Natural Language Processing using Chat GPT

Table-I (B)
List of Discipline Specific Electives (DSE)

Specialization Track – Cyber Security and Forensics

SN	DSE	Semester	Course Code	Course Name
1.	I	I	CY23B101	Foundation to Artificial Intelligence, Data Science and Cyber Security
2.	II	II	CY23B201	Python for Cyber Security
3.	III	II	CS20B108	Introduction to Computational Thinking
4.	IV	III	CY23B301	Foundation to Cyber Security and Digital Forensic
5.	V	III	CS20B209	Analog and Digital Communication
6.	VI	IV	CY23B401	Cryptography with Python
7.	VII	IV	CS20B402	Data Communication
8.	VIII	V	CY23B501	Windows Digital Investigation with PowerShell and Python
9.	IX	V	CS20B505	Internet of Things
10.	X	VI	CY23B601	Ethical Hacking and Penetration Testing
11.	XI	VI	CS23B604	Microprocessor and Interfacing
12.	XII	VII	CY23B701	Mobile Forensic
13.	XIII	VII	CY23B702	Cyber Security Attack and Defense Strategies

Table-I (C)
List of Discipline Specific Electives (DSE)

Specialization Track – Data Analytics

SN	DSE	Semester	Course Code	Course Name
1.	I	I	DA23B101	Introduction to Data Analytics
2.	II	II	DA23B201	Programming for Data Analytics in Python
3.	III	II	DA23B202	Statistical Methods for Data Analytics
4.	IV	III	DA23B301	Data Wrangling and Cleaning
5.	V	III	DA23B302	Tools and Techniques for Business Analytics
6.	VI	IV	DA23B401	Machine Learning for Data Analytics
7.	VII	IV	DA23B402	Data Visualization
8.	VIII	V	DA23B501	Big Data Analytics
9.	IX	V	DA23B502	Predictive and Time Series Analysis
10.	X	VI	DA23B601	Deep Learning
11.	XI	VI	DA23B602	Business Intelligence
12.	XII	VII	DA23B701	Cloud Computing for Data Analytics
13.	XIII	VII	DA23B702	Natural Language Processing

Table-I (D)
List of Discipline Specific Electives (DSE)

Specialization Track – Cloud Computing

SN	DSE	Semester	Course Code	Course Name
1.	I	I	CC23B101	Foundations of Computing
2.	II	II	CC23B201	Software Development and Web Technologies
3.	III	II	CC23B202	Introduction to Cloud Computing
4.	IV	III	CC23B301	Cloud Strategy and Management
5.	V	III	CC23B302	Cloud Infrastructure and Services
6.	VI	IV	CC23B401	Data Storage and Management in Cloud
7.	VII	IV	CC23B402	Virtualization and Containerization
8.	VIII	V	CC23B501	DevOps and Cloud Automation
9.	IX	V	CC23B502	Advanced Cloud Solutions
10.	X	VI	CC23B601	Cloud based Data Science and Analytics
11.	XI	VI	CC23B602	Fundamentals of Internet of Things
12.	XII	VII	CC23B701	Cloud Security and Risk Management
13.	XIII	VII	CC23B702	Cloud Security and Networking

Table-II

List of Generic Electives

Students of all Undergraduate programs are required to study one generic elective in each of the semesters from 3rd to 6th. They may choose any one of the following courses **(excluding the courses offered by the parent departments, if not stated otherwise).**

Generic Electives for III Semester

SN	Code	Nomenclature of the Course	Offering School
1.	GE20B301	Introductory Biology	School of Sciences
2.	GE20B302	Basic Analytical Chemistry	School of Sciences
3.	GE20B303	Basic Instrumentation Skills	School of Sciences
4.	GE20B304	Elementary Number Theory	School of Sciences
5.	GE20B305	Production Technology for Vegetable and Spices	School of Agriculture
6.	GE20B306	General Studies – I	School of Arts, Humanities and Social Sciences
7.	GE20B307	Basics of Acting	School of Performing Arts
8.	GE20B308	C++ Programming	School of Engineering and Technology
9.	GE20B309	Photography	School of Journalism and Mass Communication
10.	GE20B310	Introduction to Retail Chain System	School of Commerce

Generic Electives for IV Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B401	Genetics and Society	School of Sciences
2.	GE20B402	Green Chemistry and Green Methods in Chemistry	School of Sciences
3.	GE20B403	Electrical circuit Network Skills	School of Sciences
4.	GE20B404	Introduction to statistical methods and Probability	School of Sciences
5.	GE20B405	Farming System & Sustainable Agriculture	School of Agriculture
6.	GE20B406	General Studies – II	School of Arts, Humanities and Social Sciences
7.	GE20B407	Bollywood's Signature Moves	School of Performing Arts
8.	GE20B408	R Programming	School of Engineering and Technology
9.	GE20B409	Typography	School of Design
10.	GE20B410	Building Leadership &Fellowship Skills	School of Commerce

Generic Electives for V Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B501	Biotechnology	School of Sciences
2.	GE20B502	Pharmaceutical Chemistry	School of Sciences
3.	GE20B503	Digital, Analog and Instrumentation	School of Sciences
4.	GE20B504	Applications of Mathematic in Finance and Insurance	School of Sciences
5.	GE20B505	Crop Improvement-I	School of Agriculture
6.	GE20B506	Civil Services Aptitude Test – I	School of Arts, Humanities and Social Sciences
7.	GE20B507	Mime	School of Performing Arts
8.	GE20B508	Web designing	School of Engineering and Technology
9.	GE20B509	Fine Arts	School of Design
10.	GE20B510	Resolving Conflicts and Negotiation Skills	School of Commerce

Generic Electives for VI Semester

SN	Code	Nomenclature of the course	Offering School
1.	GE20B601	Bioinformatics and Systems Biology	School of Sciences
2.	GE20B602	Pesticide Chemistry	School of Sciences
3.	GE20B603	Elements of Modern Physics	School of Sciences
4.	GE20B604	Mathematical Modeling	School of Sciences
5.	GE20B605	Post Harvest Management and Value Additionof Fruits and Vegetables	School of Agriculture
6.	GE20B606	Civil Services Aptitude Test – II	School of Arts, Humanities and Social Sciences
7.	GE20B607	Body Movement (Expressing through Body nuances)	School of Performing Arts
8.	GE20B608	Python programming	School of Engineering and Technology
9.	GE20B609	Digital learning-Adobe cloud	School of Design
10.	GE20B610	Introduction to IFRS	School of Commerce

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

I Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	ENVIRONMENTAL STUDIES & DISASTER MANAGEMENT	Total Lecture: 30
UC20B101		(LTP=2-0-0=2)

Course Objectives:

- Understand the natural environment and its relationships with human activities.
- Characterize and analyze human impacts on the environment.
- Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
- Capacity to integrate knowledge and to analyses, evaluate and manage the different public health aspects of disaster events at a local and global levels.
- Capacity to obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios.

UNIT	CONTENTS	HOURS
I	**Introduction to Environment:** Definition, Components of Environment, Relationship between different components, Man- Environment relationship, Impact of Technology on the environment, Environmental Degradation, Sustainable Development, Environmental Education.	5
II	**Ecology & Ecosystems:** Introduction: Ecology- Objectives and Classification, Concepts of an ecosystem- structure & function of ecosystem, Components of ecosystem- Producers, Consumers, Decomposers, Energy flow in the ecosystem - Ecological succession, Food chains, food webs and ecological pyramids, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems and its types, Bio- Geo- Chemical Cycles - Hydrological Cycle, Carbon cycle, Oxygen Cycle, Nitrogen Cycle, Sulfur Cycle.	7
III	**Environmental Pollution:** Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like SPM, SO2, NOX , Natural & Anthropogenic Sources, Effects of common air pollutants, Air Pollution Episodes, Sound and Noise measurements, Sources of Noise Pollution, Ambient noise levels, Effects of noise pollution, Noise pollution control measures, Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants, Eutrophication, Water Pollution Episodes, Global Warming and Green Houses Effect, Acid Rain, Depletion of Ozone Layer.	7
IV	**Energy Resources:** Renewable & Nonrenewable Resources: Renewable Resources, Nonrenewable Resources, Indian Scenario, Conventional Energy Sources & its problems, non-conventional energy sources- Advantages and its Limitations	4
V	**Disaster Management:** Natural Disasters and its types, Accidental Disasters, Impact of Disasters on Trade and International Trade, Introduction, Natural disasters , Earthquakes, Hurricanes, Tornadoes, Floods, Drought, Tsunami, Volcanoes, Cyclones and Storms, Forest Fires, Severe Heat Waves, Landslides and Avalanches, Epidemics and Insect Infestations, Technological and Social Disasters Types of Technological Hazards, Social Disasters, Political and Crowd Disasters, War and Terrorism, Components of Disaster Management, Government's Role in Disaster Management through Control of Information, Actors in Disaster Management, Organizing Relief measures at National and Local Level, Psychological Issues, Carrying Out Rehabilitation Work, Government Response in Disaster	7

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO1	**Understand**[2] the importance of Environment.
CO2	**Understand**[2] the knowledge of Ecology & Ecosystems.
CO3	**Analyze**[3] to impart basic knowledge about Environment Pollution & theirs Remedies.
CO4	**Understand**[2] about Energy Resources.
CO5	**Understand**[2] about Disaster Management.
Text Books	• Dr. N. S. Varandani (2013): **Basics of Environmental Studies** Books India Publications. • Mukesh Dhunna (2011): **Disaster Management,** Delhi Publication: Vayu Education of India. • Benny Joseph (2017): **Environmental Studies**: McGraw Hills Education,
Reference Books	• R. Rajagopalan (2015): **Environmental Studies**: Oxford University, Press Publication. • Richard T Wright & Bernard J Nebel (2002): **Environmental Science**: Prentice Hall India Publication. • Daniel B. Botkin & Edward A Keller (2014): **Environmental Science**: Wiley Publications.

COURSE CODE	COMMUNICATION SKILLS	Total Lecture: 30
UC20B102		2– 0– 0-2

Course Objectives:

The purpose of this course is to introduce students to the theory, fundamentals and tools of communication and to develop in them vital communication skills which should be integral to personal, social and professional interactions. Along with the above mentioned, care has been taken to enhance the grammatical skills of the students with sufficient practical purposes. The recommended readings given at the end are only suggestive; the students and teachers have the freedom to consult other materials on various units/topics given below. Similarly, the questions in the examination will be aimed towards assessing the skills learnt by the students rather than the textual content of the recommended books. The students are advised to arrange the prescribed texts well before beginning the classes.

The course provides good introduction and understanding about the following:

- The concept and understanding of different types of Communication
- Introduce different tools of communication that are useful in various techniques of problems solving.
- The Grammatical knowledge of Language learning with the enhancement of word power.
- To introduce the tricks and methods of official and technical writing.

UNIT	CONTENT	HOURS
I	**Introduction:** Theory of Communication, Types and Modes of Communication, Effective Communication, Barriers of Communication, Strategies to overcome the Barriers	3
II	**Professional Skills:** Social skills - small talks and leading the Conversation, conducting Debate and Discussions, Public Speaking, Public Speech, Presentation skills and Meeting etiquettes, Business Communication, GD and Interview Skills, Critical Conversations	3
III	**Cross Cultural Communication:** Contextual Conversation, do's and don'ts of Cross Cultural Communication, Verbal and Non Verbal Communication, Bias and Prejudice, Body Language.	3
IV	**Internet Etiquettes:** Email writing, Social Media Articles/Blogs, Notes, Memos, Reports & Proposal Writing, Writing Letters, Formal & Informal. Self-profiling - Making Job Resume/CV, Elevator Pitch (3 minutes self- introduction during interviews), Twitter/ Facebook bio.	3
V	Critical Thinking:Where the Mind is without Fear: Rabindranath Tagore The Portrait of a Lady: Khushwant Singh, On the Rule of the Road: AG Gardiner Cherry Tree: Ruskin Bond, Close Reading, Comprehension, Analysis and Interpretation, Paraphrasing and Summary	3

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	Students will **apply**[3]correct usage of English grammar in writing and speaking.
CO 2	Students will **analyze**[4] and improve their speaking ability in English both in terms of fluency and comprehensibility
CO 3	Students will **evaluate**[5] themselves by giving oral presentations and will receive feedback on their performances.
CO 4	Students will **develop**[3] their reading speed and comprehension of academic articles
CO 5	Students will **compare**[5] their reading fluency skills.
Text Books:	• EASTWOOD, J. **Oxford practice grammar**1999 - Oxford University Press – Oxford • MURPHY, R. **English grammar in use**2012 - Cambridge University Press - Cambridge • **Fluency in English** - Part II, Oxford University Press, 2006. • **Language, Literature and Creativity**, Orient Black s • wan, 2013.
Reference Books:	• **Warriner's English Grammar and Composition**: Complete Course - John E. Warriner, Harcourt, Brace, Jovanovich (1973) • ALEXANDER, L. G. **Longman English grammar practice**1999 - Longman - New York • BEAUMONT, D. AND GRANGER, C. **The Heinemann English grammar**1992 - Heinemann – Oxford

COURSE CODE	**ENGINEERING MATHEMATICS- I**	**Total Lecture: 60**
MA20B103		**(LTP=4-0-0=4)**

Course Objectives:

The objective is to provide essential knowledge of basic tools of Matrix Algebra, Differential Calculus, Integral Calculus, Vector Calculus and Vector spaces.

The course provides good introduction and understanding about the following:

- Working with matrices and using it as tool in solving the system of equations, learning to find eigen values and eigenvectors of a matrix and use it for diagonalization of a matrix.
- The concept and use of differential calculus in tracing of curves in different coordinate systems, partial differentiation, Homogeneous functions and its use in Euler's theorem and minimization/ maximization of the function.
- The concept of higher order integration and its application in finding length, area and volume.
- The concept of vector differentiation and integration.
- The concept of Vector Spaces, Sub spaces, Basis of a vector space and Linear Transformations.

UNIT	**CONTENTS**	**HOURS**
I	Rank of a matrix, Inverse of the matrix, solution of linear simultaneous equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal and Unitary matrices and their elementary properties. Eigen values and Eigen vectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix.	**12**
II	Expansion of functions of one variable using Taylor's and Maclaurin's theorem,, Partial differentiation, homogeneous functions, Euler's theorem and its extension up to second order, Differentiation of composite functions, Taylor's series expansion of function of two or more variable, Maxima and Minima of function of two or more variables, Lagrange method of undetermined multipliers.	**12**
III	Brief review of curve tracing (Cartesian, polar and parametric), area of curve, length of curve, volume and surface area of the surface formed by revolution of curve about an axis, beta and gamma functions and their applications in real integration, Double, triple integrals, change of order of integration, area and volume of the surfaces using multiple integrals.	12
IV	Vector differentiation, gradient, directional derivative, divergence & curl of vector point function, Line Integral, Surface Integral, Gauss Divergence Theorem, Stokes theorem & Green's Theorem.	12
V	Vector Space, Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space, Linear Transformations	12

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO1	Utilize3 matrices as tool in solving linear systems and determine if a given matrix is diagonalizable.
CO2	Apply3differential calculus in tracing of curves, series expansion of functions, solving maximization/ minimization problems.
CO3	Utilize3 concepts of integral calculus in finding area and volume over higher dimensional domain
CO4	Evaluate5 integrals of functions or vector-related quantities over curves, surfaces, and domains in two- and three-dimensional space.
CO5	Define1 vector spaces, sub spaces, basis of a vector space and Linear Transformations.
Text Books	• Grewal. B. S. (2017): Higher Engineering Mathematics, 43rd Edition, Delhi: Khanna Publishers. • Das H K (2019): Advanced Engineering Mathematics, 22nd Edition, Bhopal Madhya Pradesh: S. Chand. • Hill Tim (2018): Essential Permutations & Combinations. A Self-teaching Guide, Questing Vol. Press.
Reference Books	• Kreyszig E (2011): Advanced Engineering Mathematics, 9th edition, U. K: John Wiley and Sons, Inc. • Poole D (2005): Linear Algebra: A Modern Introduction, 2nd Edition: Brooks/Cole. • B. V. Ramana (2010): Higher Engineering Mathematics, 11th Reprint, New Delhi: Tata McGraw Hill.

COURSE CODE	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	Total Lecture: 45 Practical: 15
EE20B202		(LTP=3-0-2=4)

Course Objectives:

- Provide working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices
- Students will gain knowledge regarding the various laws and principles associated with electrical systems.
- Students will gain knowledge regarding Fundamentals of Electrical Machines
- Student will gain knowledge. Evolution and Impact of Electronics in industries and in society
- Student will gain knowledge on electronic systems. & field of electrical & electronics engineering.

UNIT	CONTENTS	HOURS
I.	**D. C. Circuits:** Basic Laws**:** Ohm's law**,** Kirchhoff's voltage and current laws**,** Nodes-Branches and loops**,,** Mesh analysis and Nodal analysis**,** Series elements and Voltage Division**,** Parallel elements and Current Division**,** Star-Delta transformation**,** Independent sources and Dependent sources**,** source transformation. Superposition theorem**,** Thevinin's theorem **Basic electrical parameter measuring Instruments** Voltmeters & ammeter**,** wattmeter**,** energy meter	**10**
II.	**AC Fundamentals-I:** Reviews of Complex Algebra**,** Sinusoids**,** phasors**,** Phasor Relations of circuit elements**,** Impedance and admittance**,** Impedance Combinations**,** Series and Parallel combination of Inductors and capacitor.	**10**
III.	**AC Fundamental-II:** RMS and average values**,** Form factors**,** Steady state Analysis of series**,** Parallel and Series Parallel combination of R**,** L**,** C with Sinusoidal excitation**,** Instantaneous power**,** Real power**,** Reactive power and Apparent power**,** concept of Power factor**,** Frequency.	**9**
IV.	**Fundamentals of Electrical Machines:** Construction**,** Principle**,** Operation and Application of –(i) Single phase Transformer (ii) Single phase Induction motor (iii) DC Motor.	**8**
V.	**Evolution and Impact of Electronics in industries and in society,** Familiarization with Resistors**,** Capacitors**,** Inductors**,** PN Junction diode**:** Structure**,** Principle of operation**,** various types of Diode**,** Bipolar junction transistors (BJT)**,** Half wave and full wave rectifiers**,** Basics of CRO (analog & digital):	**8**

List of Experiments:

- To verify Kirchhoff's Voltage.
- To verify Kirchhoff's Current laws.
- To verify Thevenin's theorem
- To verify superposition theorem
- To study star and delta connection for a 3-Φ AC circuit.
- To measure the active and reactive power in single phase ac circuit.
- To obtain the transient response and measure the time constant of a series RL and RC circuit for a pulse waveform.
- To study and verify the various digital logic gates
- To study of various electronic devices
- To study PN Junction Diode characteristics.
- Verification of truth table for various gates**,** Flip-Flops.
- Verification of De Morgan's theorems.
- Study of V-I Characteristics of Diodes.
- To study and plot VI characteristics of semiconductor diodes

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Understand**[2] the basic properties of electrical elements**,** and solve DC circuit analysis problems. DC network theorems.
CO 2	**Understand**[2] the fundamental behavior of AC circuits and solve AC circuit problems**. Apply** the knowledge gained to explain the behavior of the circuit at series & parallel resonance of circuit & the effect of resonance.

CO 3	**Remembering**[1] to impart basic knowledge of electrical quantities such as current**,** voltage**,** power**,** energy and frequency
CO 4	**Understand**[2] the concepts of fundamentals of Electrical Machines
CO 5	**Understand**[2] the concepts of Electronics in industries and in society**,** transformers and their applications**,** Semiconductors Devices**,** Rectifiers.
Text Books	• Gupta J. B : **Basic Electrical & Electronics Engineering,** New Delhi : Tata McGraw Hill • Theraja B. L. & Theraja A. K. : **Textbook of Electronics Device & Circuit** - Vol. IV**,**New Delhi: S. Chand Publication. • Kothari D. P. & Nagrath, I. J: **Basic Electrical Engineering**, New Delhi: Tata McGraw Hill, latest edition.
Reference Books	• D. P. Kothari & I. J. Nagrath: **Basic Electrical Engineering**, New Delhi: Tata McGraw Hill**,** latest Edition. • Singh S. N. (2013): **Basic Electrical Engineering,** U. S. A. : PHI • Rajendra Prasad(2014): **Fundamentals of Electrical Engineering,** U. S. A: Prentice Hall • Sukhija**,** M. S. , Nagsarkar T. K. (2012): **Basic Electrical and electronics Engineering**, : U. P. : Oxford University press

COURSE CODE	ENGINEERING DRAWING	Total Lecture: 45 Practical: 15
ME20B105		(LTP=3-0-2=4)

Course Objectives:

This course is design to develop understanding of Engineering Drawing to undergraduate students. It covers various areas of engineering drawing. Principle program outcomes of the course are listed below:

- To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- To prepare you to communicate effectively
- To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT	CONTENTS	HOURS
I.	Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, usage of Drawing instruments, Conic sections ellipse, parabola, Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal, Vernier Scales and scale of chords.	10
II.	Orthographic Projections, Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes	10
III.	Projections of Regular Solids those inclined to both the Planes, Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone, Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.	9
IV.	Isometric Projections, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.	8
V.	Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software, Auto Cad [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects. ; Isometric Views of lines, Planes, Simple and compound Solids.	8

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Use**[3] the drawing instruments effectively and able to dimension the given figures. Appreciate the usage of engineering curves in tracing the paths.
CO 2	**Understand**[2] the concept of projection and acquire visualization skills, projection of points.
CO 3	**Define** [1] the basic views related to projections of Solid. To know development of different types of surfaces.
CO 4	**Compare**[4] & understand isometric projection & Orthographic Projection
CO 5	**Use**[2] Autocad software.
Text Books	• N. D, Bhatt (2014): **Elementary Engineering Drawing,** 53rd EDITION, Gujarat: Charotar Publishing House. • Dhawan R. K (2011): **Engineering Drawing,** 2nd EDITION, New Delhi: S. chand publication. • Agarwal Basant and Agarwal C. M. (2019): **Engineering Drawing,** New Delhi, TMH publication.
Reference Books	• P. S Gill (2013): **Engineering Drawing & Engineering Graphics,** 3rd Edition, New Delhi: S. K. Kataria & Sons. • Lakshmi narayan L. V. and Vaish R. S (2010): **Engineering Graphics,** New Delhi: Jain Brothers.

COURSE CODE	PROGRAMMING PRACTICE –I	Practical: 30
CS20B106		(LTP=0-0-4=2)

Course Objectives:

- Able to implement the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
- Demonstrate an understanding of computer programming language concepts.
- Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.

UNIT	CONTENTS	HOURS
I.	Basics of Computer Hardware and Software Basics of Computer Architecture: processor, Memory, Input & Output devices Application Software & System software: Compilers, interpreters, High level and low level languages Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (bubble sort, linear search - algorithms and pseudocode)	7
II.	Program Basics Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types, Constants, Console IO Operations, printf and scanf Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements. (Simple programs covering control flow)	6
III.	Arrays and strings Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets) Linear search program, bubble sort program, simple programs covering arrays and strings	5
IV.	Working with functions Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, simple programs using functions	6
V.	Pointers and Files Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer, array access using pointers, pass by reference effect File Operations: open, close, read, write, append Sequential access and random access to files: In built file handling functions (rewind(), fseek(), ftell(), feof(), fread(), fwrite()), simple programs covering pointers and files.	6

List of Experiments:

1. Write a program to print sample string like “hello world” with different format.
2. Write a program to print different data types in ‘c’ and their ranges.
3. Write a program to printing a variable of different data types.
4. Write a program to demonstrate arithmetic operators.
5. Write a program to demonstrate logical operators.
6. Write a program to read radius value from the keyboard and calculate the area of circle and print the result both floating and exponential notation.
7. Write a program to calculate simple interest.
8. Write a program to convert temperature. (Fahrenheit-centigrade and vice-versa.
9. Write a program to demonstrate relational operators.
10. Write a program to check equivalence of two number’s using conditional operator.
11. Write a program to demonstrate pre-increment and post-increment.
12. Write a program to demonstrate pre- decrement and post- decrement.
13. Write a program for computing volume of cylinder, sphere and cone assume that dimensions are integer’s use type casting where ever necessary.
14. Write a program to read marks of a student in six subjects and print whether pass or fail.
15. Write a program to calculate roots of quadratic equation.
16. Write a program to perform arithmetic operation’s using switch case.
17. Program on 1D and 2D arrays.
18. Program on function.
19. Program on string function.

Program on pointers.

Course Outcome as per Bloom’s Taxonomy

At the end of the course the students will be able to**:**	
CO 1	**Understand**[2] the computer programming language concepts.
CO 2	**Define**[1] data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures.
CO 3	**Define**[1] union and enumeration user defined data types.
CO 4	**Design**[6] Computer programs**,** analyzes**,** and interprets the concept of pointers**,** declarations**,** initialization**,** operations on pointers and their usage.
CO 5	**Develop**[6] confidence for self education and ability for life-long learning needed for Computer language
Text Books	• Balagurusamy E. (2006): **Programming in ANSI C,** 15th Edition**,**Noida: Mcgraw Hill. • Kamthane**,** Asok N (2011): **Programming in C,** 2nd Edition**,** Delhi: Pearson. • Gottfried B. S. (1996): **Programming with C,** Schaum Series**,** 2nd Edtion**,** Noida: Tata McGrawHill.
Reference Books	• Goel Anita and Mittal Ajay (2016)**:** **Computer fundamentals and Programming in C,** Delhi: Pearson publication • Kernighan Brian W. and Ritchie Dennis M (2015): **C Programming Language,** Delhi: Pearson • Rajaraman V (2019): **Computer Basics and Programming in C**: PHI

COURSECODE	PROJECT BASED LEARNING-I	Practical: 30
PB20B101		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
- For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks.
- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
  - Introduction
  - Review of literature
  - Methodology
  - Result and Discussion
  - Conclusion and Project Outcomes
  - References
- Student will need to submit three copies for
  - Concerned School
  - Central Library
  - Self
- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

II Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	ENTREPRENEURSHIP DEVELOPMENT	Total Lecture: 30
UC20B202		(LTP=2-0-0=2)

Course Objectives:
Develop understanding and confidence in students to venture into entrepreneurship by giving them baseline understanding of the various aspects impacting decision making on various frontiers as faced by an enterprise

UNIT	CONTENTS	HOURS
I.	Introduction: Entrepreneur – meaning, evolution, importance, qualities, nature, types, traits. Entrepreneurship development - its importance, role of Entrepreneurship. Entrepreneurial environment, culture and stages in entrepreneurial process, changing dimensions in entrepreneurship – Digital entrepreneurship. Entrepreneur Vs. Intrapreneur, Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager; Role of Entrepreneur in Indian economy and developing economies with reference to Self-Employment Development Entrepreneurial Culture	7
II.	Starting A New Venture: Generating business idea – sources of new ideas, methods of generating ideas, opportunity recognition. Choice of the organization: Sole Proprietorship, partnerships, Joint Stock Co. , Co-Operatives Family Business – meaning, characteristics, importance, types and models. Growing and evolving family business – Complexity of family enterprise – Diversity of successions; Different Dreams and challenges. Feasibility study – market feasibility, technical/operational feasibility, financial feasibility, environmental scanning, competitor and industry analysis. Drawing business plan - preparing project report, presenting business plan to investors.	7
III.	Financing and Managing New Venture: Financing and Managing the new venture, Source of capital, Record Keeping, financial controls, Marketing and sales control. Internet advertising Features and evaluation of joint ventures. Basic Government Procedures to be complied with; Policies governing SMEs – Steps in setting up a small unit. Type of business- Large Scale/ MSME; Judging Funding requirements of the business; New Generation Funding sources- Venture Capital Funding, SME Funding, Angel Investors etc	5
IV.	Institutional support and government initiatives for Entrepreneurs': Role of Directorate of Industries, Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Industrial Development Corporation (IDC), State Financial Corporation's (IFCs), Commercial Banks, Small Scale Industries Development Corporations (SSIDCs), Khadi and Village Industries Commission (KVIC), Industries Service Institute (SISI), NABARD, National Small Industries corporation (NSIC), Small Industries Development, Bank of India (SIDBI) and other relevant institutions / organizations. Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants.	6
V.	New Venture Expansion and Exit Strategies: Joint Ventures, Acquisitions, mergers, franchising, public issues, right issues, bonus issues and stock issues. Exit Strategies, Reasons for exiting and long and short term preparation, CSR, Dimensions of CSR	5

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Develop**[3] managerial qualities and competencies of an entrepreneur.
CO 2	**Acquaint**[2] himself with the challenges of starting a new venture and the process of setting up a business.
CO 3	**Build**[3] essential skills and creativity needed to build teams and work in and with them.
CO 4	**Know**[1] the essential procedure and funding avenues for setting up a new business.
CO 5	**Learn**[1] the various government initiatives and accordingly plan for his business.
Text Books	• Varshainey G. K. (2019): **Fundamental of Entrepreneurship,** Bangalore: Sahitya Bhawan Publications. • Bharti, A. N. , Tripathi Pramodh Kumar (2021-22): **Fundamental of Entrepreneurship** Agra, U. P. : Rajeev Sahitya Bhawan Publication, SBPD Publication. • H. Nandan (2013): **Fundamental of Entrepreneurship,** New Delhi, Delhi, Third Edition: PHI Learning. • K. Nagarajan. (2017): **Project Management,** Second Edition, New Delhi: New Age International,

Reference Books	• Peters Hisrich (2017): **Entrepreneurship,** Tenth Edition**,** Noida: Mc Graw Hills. • Berger Brigitt **(**1991**)**: **The Culture of Entrepreneurship,** Chennai: ICS Pt. • Steven Brandt (1997): **Entrepreneuring: 10 Commandments for Building a Growth Company (Build Your Business Guides),** Third Edition**,** Singapore: Archipelago Pub. • Gurmit Narula (2002): **The Entrepreneurial Connection**, Noida: Tata McGraw Hills.

COURSE CODE	ENGINEERING MATHEMATICS - II	Total Lecture: 60
MA20B204		(LTP=4-0-0=4)

Course Objectives:

The objective is to acquaint the students with basic knowledge of Ordinary and Partial Differential Equations, Calculus of complex functions, Laplace and Inverse Laplace Transform, and Sequences and Series and specifically Fourier Series. The course provides good introduction and understanding about the following:

- The concept and understanding of different analytical techniques of solving first and higher order ordinary and partial differential equations.
- Introduce the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems.
- The concept of Laplace and Inverse Laplace Transform and its application.
- The method of testing convergence of sequences and series and concept of Fourier series.

UNIT	CONTENTS	HOURS
I.	Differential Equation of First Order and Higher Degree, Linear Differential Equation with Constant Coefficient of Higher Order, Cauchy's Differential Equation, Method of Variation of Parameter, Simultaneous Differential Equation, Introduction to series solution method.	12
II.	Formation of first and second order partial differential equations. Linear & Non-Linear partial differential equation of First Order, Homogeneous & Non-Homogeneous Linear P. D. E with constant coefficient of Higher Order, Separation of Variables, Wave equation & Heat Equation.	12
III.	Analytic functions, C-R equations, necessary and sufficient conditions, Harmonic conjugates, Milne's method, complex line integration, Cauchy's theorem for simply and multiply connected domains, Cauchy's integral formula for the derivatives of an analytic function, Taylor series, Laurent series, Zeros and poles of a function, residue at a singularity, Residue theorem, its applications for the Evaluation of Real Definite Integral.	12
IV.	Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem. Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Solution of differential equation by using Laplace transforms.	12
V.	Sequences, Series, Convergence, Tests for convergence of series (Comparison tests, D'Alembert's Ratio test, Integral test, Raabe's, Cauchy's Root test, Logarithmic), Fourier series: Half range sine and cosine series.	12

Course Outcome as per Bloom's Taxonomy

CO 1	**Define**[1] and differentiate between ordinary and partial differential equations and solve different boundary value problems in engineering
CO 2	**Define**[1] functions of complex variable, their differential and integral calculus and utilize it in evaluating real integrals
CO 3	**Understand**[2] and apply Laplace transformation in finding solution of differential equations in engineering
CO 4	**Evaluate**[5] the convergence or divergence of various sequences and series utilizing appropriate tests.
CO 5	**Formulate**[6] and find solution of more complicated engineering problems.
Text Books	• Grewal B. S (2017): **Higher Engineering Mathematics,** 43rd Edition, Delhi: Khanna Publishers. • Das H. K. (2019): **Advanced Engineering Mathematics,** New Delhi, 22nd Edition: S Chand. • Jain R. K. and Iyenger S. R. K. (2016): **Advanced Engineering Mathematics,** 5th Edition, New Delhi. : CRC Press, Narosa Publishing House.
Reference Books	• Kreyszig E. (2011): **Advanced Engineering Mathematics,** 9th edition, U. K.: John Wiley and Sons, Inc. , • Poole D. (2005): **Linear Algebra: A Modern Introduction,** 2nd Edition: Brooks/Cole. • Ramana B. V(2010): **Higher Engineering Mathematics,** 11thReprint. , New Delhi: Tata McGraw Hill.

COURSE CODE	ENGINEERING PHYSICS	Total Lecture: 45 Practical: 15
PY20B104		(LTP=3-0-2=4)

Course Objectives:

The main objective of the course is to introduce the student to various branches of physics which plays a significant role in the understanding and development of modern day technology.

The course provides good introduction and understanding about the following**:**

The origin of quantum mechanics**,** dual nature of matter**,** Wave function and its interpretation**,** Schrodinger wave equation and application.

The electric and magnetic field for a given charge and current distribution**,** Maxwell equation and its significance.

The wave nature of light including Hygen's principle**,** interference**,** diffraction and resolving power of grating and prism.

The spontaneous and stimulated emission and how the concept of stimulated emission explains the production of laser beam.

Principle of propagation of light in optical fiber.

The semiconductor (p and n type)**,** the theory for semiconductor's energy level**,** various semiconductor devices and basic of digital electronic.

UNIT	CONTENTS	HOURS
I	**Quantum Mechanics for Engineers** Introduction to Quantum mechanics**,** Davisson Germer experiment**,** Wave nature of Particles**,** Time-dependent and time independent Schrodinger equation for wave function**,** Born interpretation**,** probability current**,** Expectation values**,** Free-particle wave function and wave- packets**,** Uncertainty principle and its experimental verification**,** Solution of stationary-state Schrodinger equation for one dimensional problems– particle in a box	10
II	Electrodynamics Coulomb's law in vector form, Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential, Boundary conditions of electric field and electrostatic potential, energy of a charge distribution and its expression in terms of electric field, Gauss Divergence theorem, Stokes' theorem; Continuity equation, Maxwell equation and its significance	8
III	Wave Optics Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Fresnel's biprism, Thin film interference, Newton's rings, Michelson interferometer, Farunhofer diffraction from a single slit, double slit and circular aperture Diffraction gratings, Rayleigh criterion for limit of resolution and its application to vision, Resolving power of grating and prism.	10
IV	Laser and Fiber optics Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, Component of laser, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), Properties of laser beams, applications of lasers in science, engineering and medicine, Introduction to fibre, total internal reflection, acceptance angle and cone, Numerical aperture, V-number, Types fibre, fibre losses, Attenuation constant, Types of dispersion, Intermodal dispersion in graded index fibre. Fibre optics communications system	8
V	Semiconductor and Digital Electronics Band theory of metals, Fermi level, Intrinsic and extrinsic semiconductor, Hall Effect, Fabrication of PN junction diodes, V-I characteristics of PN junction, Zener diode, Tunnel diode, Solar Cell, Basic concepts of Transistor, Logic gates and number system (binary, hexadecimal, and octadecimal), Flip Flop Circuits	9
	List of Experiments: 1. To determine the resistivity of a semiconductor as a function of temperature and to estimate its band gap using four-probe method. 2. Radius of curvature of plano convex lens using Newton's rings. 3. To study the single slit diffraction by laser light. 4. Determination of wavelength different colour of light using diffraction grating. 5. To determine the value of Planck's constant by measuring radiation in a fixed spectral range. 6. To determine the wavelength of sodium light by Newton's Ring. 7. V-I Characteristics of PN Junction. 8. V-I Characteristics of Zener diode. 9. V-I Characteristics of Solar cell 10. Determine the frequency of AC mains 11. Determine the height of Tower using Sextant	

Course Outcome as per Bloom's Taxonomy	
At the end of the course the students will be able to:	
CO 1	Define[1] interference and diffractions of light in different conditions.
CO 2	Apply[3] the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to a matter wave system.
CO 3	Differentiate[3] the solids on the basis of band theory and to calculate conductivity of semiconductors
CO 4	Describe[1] the basic laser physics, working of lasers, holography and principle of propagation of light in optical fiber.
CO 5	Conclude[5] the importance of Band theory of solid in determining the properties of metals; understand the concept of logic gates and number system.
Text Books	• Gaur R. K and S. L. Gupta (2012): Engineering Physics, New Delhi: Dhanpat Rai Publications. • Khan Md. M. & Panigrahi, S. : Principle of Physics, Vol. I & Vol. II, Cambridge Univ. Press.
Reference Books	• Maharana L. , Panda Prafullaku, Dash Sarat Ku. , Ojha Babita (2019): Lectures on Engineering Physics, New Delhi NCR: Pearson. • Bhattacharrya D. K. and Tondon Poom (2015): Engineering Physics lucknow uttarpradesh, Oxford University Press.

COURSE CODE	LOGIC FOR COMPUTER SCIENCE	Total Lecture: 45
CS24B206		(LTP=3-0-0=3)

Course Objectives:

- To learn Boolean Algebra and Understand the various logic gates
- To be familiar with various combinational circuits
- To introduce the main notions of mathematical logic
- To study formal frameworks for constructing logical arguments

UNIT	CONTENTS	HOURS
I	Binary numbers, Octal and Hexadecimal numbers, Number base conversion, Arithmetic operations with different bases, Logic Gates: AND, OR, NOT, NAND, NOR, XOR, Boolean Algebra, Boolean expressions, Truth tables	10
II	Introduction to Propositional Logic, Beliefs and declarative sentences, Contradictions, Formalization, Arguments, Propositional calculus	8
III	Introduction to Predicate Logic, Informal predicate calculus, First order predicate calculus, Natural deduction, Substitution and Unification.	10
IV	Skolemization, Normalization, Conversion to Horn clause, Resolution, Binary decision diagrams, Decidability & undecidability	9
V	Introduction to Tableaux, Tableaux for propositional calculus, Tableaux for predicate calculus, Soundness & completeness or predicate calculus	8

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO1	Use[2] Truth table and Boolean algebra to solve a combinational logic problem
CO2	Prove[3] logical equivalency, contingency and contradictions
CO3	Identify[2] valid, satisfiable, and unsatisfiable assertions
CO4	Prove[3] or disprove assertion using resolution
CO5	Determine[3] probability of outcomes

Text Books	• Morris Mano, and Michael D. Ciletti, "Digital Design", Fifth Edition, PHI, 2012. • Logic for Computer Science Steve Reeves and Michael Clarke. Addison-Wesley, 1990. ISBN: 0-201-41643-3
Reference Books	• First-Order Logic and Automated Theorem Proving. Melvin Fitting. Springer Verlag, Berlin, 1990. • A Mathematical Introduction to Logic. Herbert B. Enderton. Academic Press, New York, 1972. • Natural Deduction (A Proof-theoretical study). Dag Prawitz. Almqvist and Wiskell, 1965.

COURSE CODE	PROGRAMMING PRACTICE –II	Practical: 30
CS20B205		(LTP=0-0-4=2)

Course Objective: The objective of course is to develop programming skills of students**,** using object oriented programming concepts**,** learn the concept of class and object using C++ and develop classes for simple applications.

UNIT	CONTENTS	HOURS
I.	Introduction to Programming – Program and Programming –Programming Languages –Types of software's**,** Operating Systems –Dos commands –Basic Linux commands and vi editor –Compiler**,** Interpreter**,** Loader and Linker Fundamentals in C++ –History of 'C++' –Migrating from procedural oriented language –to object oriented languages Program –Keywords –Variables –Constants –Data type –Operators –Manipulators and uses –Basic Structure of a 'C++' program	**5**
II.	Control statements –Conditional Control Statements –if –if-else –nested if-else –else-if ladder –Multiple Branching Control Statement –switch-case –Loop Control Statements –while –do-while –for –Nested Loops –Jump Control statements –break –continue –goto –exit –return –Programming Examples –FAQ's	**6**
III.	Pointer array Reference –pointer variable –Reference variable/alias variables? –Reference to Reference variable? –Reference to array? –Reference vs normal variable? –Reference vs pointer variable? –1D and 2D Arrays –What is dynamic memory allocation? –The new and delete operator –new vs malloc –delete vs free –Dynamic 1D and 2D Arrays	**7**
IV.	Function –What is function ? –Why function ? –Advantages of using functions –Function Prototype –Defining a function –Calling a function –Actual and Formal Arguments –Types of functions –Parameter Passing Techniques –Call by Value –Call by Reference –Call by Pointer –Return statement –Returning More than one value From A Function –Return by value mechanism –Return by pointer mechanism –Return by reference mechanism –Inline Functions –Default Arguments –Function Overloading –Lambda function. –Recursion	**6**
V.	Introduction to oops –C structure vs C++ structuree –Class –Object –Encapsulation –Abstraction –Polymorphism –Inheritance –Message Passing Classes and Objects –Declaring / defining classes –Data members and member functions –Access specifiers**:** public and private and protected –Creating objects of a class –Pointers to object –Implicit this pointer –Static data members –Static member functions –Passing objects to a member function –Returning objects from a member function –Friend functions –Friend classes –Nested classes –Local classes –The const member functions –The const objects –Array of objects –static objects –inline functions.	**6**

List of practical

1. Write a program to prints numbers**,** alphabets and special characters on the output screen.
2. Write a program to that accept age in years from user as input and displays his age in months and days.
3. Write a program that demonstrates the use of arithmetic and assignment operators by getting two numbers from user.
4. Write a program that to calculate area of circle**,** square**,** rectangle and triangle using switch-case statements
5. Write a program to that accepts number from user and displays all the factors of that number.
6. Write a program that accepts a number from keyboard and find its factorial.
7. Write a program that accepts 9 numbers in form of matrix and display transpose of that matrix.
8. Write a program to count number of words in a sentence.
9. Write a program to create structure of book which contains book title**,** author name**,** publication and price as its members and displays book records for n books.
10. Write a program which accepts value of base and power from user and displays its value (base^ power) using UDF.
11. Write a program which should work like a strlen function using UDF.
12. Write a program that demonstrates the basic class program to get department**,** name and salary of an employee.
13. Create a class “Bank_Account” that contains Depositor_Name**,** Acc_No**,** Acc_type**,** Balance as its data members. Also create member functions for account creation**,** deposit**,** withdraw and balance inquiry for class. Demonstrate its use in main.
14. Define a class “Time”that contains following data members and member functions.
15. Data members**:** 1. Hours
1. Minutes
2. Seconds
16. Member Functions**:** 1. To get time from user
1. To display time on the screen
2. To calculate sum of two time objects
17. Write a program that can read values of Time for two objects T1 and T2**,** calculate sum and display sum using defined member functions

18. Create class "Sales"having following data members and member functions**:**
19. Data Members**:**
1. Name of Salesman
2. Sales of Salesman
20. Member functions to calculate commission
1. Commission is Rs. 10 per thousand if sales are at least Rs. 25000 or more
2. Commission is Rs. 5 otherwise
21. Write a program that calculate and print name and sales of salesman.
22. Write a program to count number objects created for particular class using constructor.
23. Create class "Person"having a two data members as person name and nationality. Also create two constructors for this class in which one has two arguments and second has one argument.
24. Write a program to declare two classes**,** each one have one int data member. Find the sum of data members of both classes using friend function. Create suitable objects and functions
25. Create Class "Circle"having radius as data member**,** constructor and member function to calculate area of circle. Class should overload = = operator to compare two circle objects whether they are equal in radius.
26. Implement following class relationship and test with main class.
27. Vehicle 1. Two-Wheeler a. Bike b. Bicycle
2. Four-Wheeler a. Car b. Truck c. Taxi

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO1	**Implement**[3] the algorithms and draw flowcharts for solving Mathematical and Engineering problems.
CO2	**Demonstrate**[2] an understanding of computer programming language concepts.
CO3	**Define**[1] data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.
CO4	**Design**[6] and develop Computer programs**,** analyzes**,** and interprets the concept of pointers**,** declarations**,** initialization**,** operations on pointers and their usage.
CO5	**Develop**[6] confidence for self education and ability for life-long learning needed for Computer language.
Text Books	• Schildt Herbert (2017): **The complete reference, C++,** 4th edition**,** Noida: Mcgraw Hill. • Bjarne (2018): **A Tour of C++** 2nd edition**,** Boston: Addison-Wesley.
Reference Books	• Lafore Robert (2008): **Object oriented programming in C++,** U. K. : Pearson. • Balagurusamy E. (2020): **Object oriented programming with C++,** Eighth edition: Mcgraw Hill

COURSECODE	PROJECT BASED LEARNING-II	Practical: 30
PB20B201		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
- For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks.
- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
  - Introduction
  - Review of literature
  - Methodology
  - Result and Discussion
  - Conclusion and Project Outcomes
  - References
- Student will need to submit three copies for
  - Concerned School
  - Central Library
  - Self
- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

III Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	QUANTITATIVE APTITUDE-I	Total Lecture: 30
UC20B302		(LTP=2-0-0=2)

Course Objectives:

- To enhance the problem solving skills
- To improve the basic mathematical skills.
- Enable students to manage the placement challenges more effectively

UNIT	CONTENTS	HOURS
I	Numbers, H. C. F & L. C. M of Numbers, Decimal Fraction, Codingdeductive logic, Data Sufficiency, Directional Sense	6
II	Simplification, Square root & Cube root, Average, Problem on Numbers & Problem on Ages, Percentage	6
III	Profit & Loss, Ratio & Proportion, Height & Distance Partnership, Chain Rule, Time & Work.	6
IV	Deductive Reasoning, Logical Word Sequence, Objective Reasoning, Selection decision tables, Puzzles	6
V	Inductive reasoning- Analogy Pattern Recognition, Classification Pattern Recognition, Coding Pattern Recognition, Number Series Pattern Recognition	6

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to**:**

CO1	Make **decisions**[5] based on analysis and critique of quantitative information using proportional reasoning. Students willalso effectively justify and communicate their conclusions in ways appropriate to the audience.
CO2	**Solve**[3] real-life problems requiring interpretation and comparison of variousrepresentations of ratios (i. e. , fractions, decimals, rates, and percentages):
CO3	**Analyze**[4] and critique mathematical models and be able to describe theirlimitations.
CO4	**Apply**[3] probabilistic reasoning to draw conclusions, to make decisions, and to evaluate outcomes of decisions.
CO5	**Distinguish**[4] between proportional and nonproportional situations and, whenappropriate, apply proportional reasoning.
Text Book	• Aggarwal R. S**. (**2020): **Quantitative Aptitude for Competitive Examinations,** New Delhi: S. Chand Publication. • Gupta D. P. & Burnwal Sanjeet (2020): **General Quantitative Aptitude for Competitive Exams** II Edition, New Delhi: Disha Publication
Reference Books	• Agrawal Deepak & Gupta D. P. (2018): **Rapid Quantitative Aptitude: WithShortcuts & Tricks for Competitive Exams,** New Delhi: Disha Publication • Guha. Abhijit (2016): **Quantitative Aptitude for All Competitive Examinations** VII Edition, Noida: McGraw Hill Education

COURSE CODE	OPERATING SYSTEM	Total Lecture: 60 Theory: 45 Practical: 15
CS20B301		(LTP= 3 – 0 – 2 = 4)

Course Objectives:

- Provides a comprehensive introduction of Operating System, Process Management, Memory Management, File Management and I/O management.
- To introduce the concept of Operating system concepts and designs and provide the skillsrequired to implement the services.
- To describe the trade-offs between conflicting objectives in large scale system design.
- To develop the knowledge for application of the various design issues and services
- The purpose of this subject is to cover the underlying concepts Operating System.

UNIT	CONTENTS	HOURS
I	Introduction to Operating Systems, evolution of OS, OS structure, functions of OS, Different Types of OS, Operating Systems Services: Types of Services, Different ways of providing these Services – Utility Programs, device drivers, System Calls.	8
II	CPU Scheduling: Process Concept, Scheduling Concepts, Types of Schedulers, Process State Transition Diagram, Inter- Process Communication, Scheduling Algorithms, Algorithms Evaluation, Concept of Threads. . Deadlocks: Deadlock Problems, Characterization, Prevention, Avoidance, Recovery. Process synchronization: critical sections, semaphores, monitors, classical problems in synchronization (producer-consumer, readers-writer, dining philosophers, etc	10
III	File Systems: File Concept, User's and System Programmer's view of FileSystem, Disk Organization, Tape Organization, Different Modules of a File System, Disk Space Allocation Methods – Contiguous, Linked, Indexed. Directory Structures, File Protection, System Calls for File Management, Disk Scheduling Algorithms.	10
IV	Memory Management: Different Memory Management Techniques – Partitioning, Swapping, Segmentation, Paging, Paged Segmentation, Comparison of these techniques, Techniques for supporting the execution of large programs: Overlay, Dynamic Linking and Loading, Virtual Memory – Concept, Implementation by Demand Paging etc.	10
V	Security & Protection Security Environment, Design Principles Of Security, User Authentication, and Protection Mechanism: Protection Domain, Access Control List Case Studies: Unix/Linux, WINDOWS and other Contemporary Operating Systems.	7

List of Experiment

1. Write a program to implement various CPU Scheduling algorithm(FCFS, SJF, Priority, Round robin)
2. Write a program to implement classical inter process communicationproblems (producer consumer, Reader Writers, Dining Philosophers)
3. Write a program to implement &various page replacement algorithms.
4. Write a program to implement & Compare various Disk & Drumscheduling Algorithms
5. Write a program to implement Banker's algorithms.
6. Case Study: ios, Android, UNIX/LINUX

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to:

CO 1	**Interpret**[2] the evolution of OS functionality, structures and layers.
CO 2	**Apply**[3] various types of system calls and to find the stages of various process states
CO 3	**Design**[3] a model scheduling algorithm to compute various scheduling criteria.
CO 4	**Apply**[3] and analyze communication between inter process and synchronizationtechniques.
CO 5	**Implement**[3]page replacement algorithms, memory management problems andsegmentation.
Text Books	• Silberschatz Avi, Galvin Peter Baer, Greg Gagne. (2012): **Operating System Concepts**, U. K: Wiley, 9/E. • Stalling William (2012): **Operating Systems** U. K. : Pearson Education. • Tanenbaum. Andrew S. (2009): **Modern Operating Systems 3/e,** U. S. : Prentice Hall.
Reference Books	• Bach Maurice J. (2015): **The Design of Unix Operating System,** U. S: Prentice Hallof India. • Bovet D& Cesati M (2019): **Understanding the Linux Kernel,** United States: O'Reily, 2/E. • Stalling William (2013): **Operating Systems: Internals and Design Principles,** 7/E, U. S. : Prentice Hall.

COURSE CODE	DATA STRUCTURE AND ALGORITHMS	Total Lecture: 60 Theory: 45 Practical: 15
CS20B302		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to:

- Introduce the fundamentals and abstract concepts of data structures.
- To design and implement various data structures.
- Understand the usage of stacks and queue.
- To teach different searching and sorting techniques
- Learn how concepts of data structures are useful in problem solving.

UNIT	CONTENTS	HOURS
I	**Introduction: Basic Terminology:** Elementary Data Organization, Algorithm, Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time-Space trade-off. Abstract Data Types (ADT)Arrays: Definition, Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Application of arrays, Sparse Matrices and their representations. Linked lists: Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.	10
II	**Stacks and Queues: Abstract Data Type:** Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Recursion, Tower of Hanoi Problem, Simulating Recursion, Principles of recursion, Tail recursion, Removal of recursion Queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue.	9
III	**Trees: Basic terminology** Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Preorder and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.	9
IV	**Graphs:** Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm, Introduction to Activity Networks.	8
V	**Searching and Sorting:** Sequential search, Binary Search, Comparison and Analysis Internal Sorting: Insertion Sort, Selection, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort, Radix Sort, Practical consideration for Internal Sorting. Search Trees: Binary Search Trees(BST), Insertion and Deletion in BST, Complexity of Search Algorithm, AVL trees, Introduction to m-way Search Trees, B Trees & B+ Trees Hashing: Hash Function, Collision Resolution Strategies Storage Management: Garbage Collection andCompaction.	9

List of Experiments:

1. Write a program that uses functions to perform the following operations on singly linked list i) Creation ii) Insertion iii) Deletion iv)Traversal.
2. Write a program that uses functions to perform the following operations on doubly linked list i) Creation ii) Insertion iii) Deletion iv) Traversal.
3. Write a program that uses functions to perform the following operations on circular linked List i) Creation ii) Insertion iii) Deletion iv) Traversal.
4. Write a program that implement stack (its operations) using i) Arrays ii) Linked list(Pointers):
5. Write a program that implement Queue (its operations) using i) Arrays ii) Linked list(Pointers):
6. Write a program that implements Circular Queue using arrays.
7. Writea program that uses both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers: a) Linear search b) Binary search.
8. Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii)Quick sort.
9. Write a program that implements the following i) Insertion sort ii) Merge sort iii)Heap sort.
10. Write a program to implement all the functions of a dictionary (ADT) using Linked List.

<table>
<tr><td colspan="2">11. Write a program to perform the following operations: a) Insert an element into a binary search tree. b) Delete an element from a binary search tree. c) Search for a key element in a binary search tree.
12. Write a program to implement the tree traversal methods
13. Write a program to perform the following operations: a) Insert an element into a AVL tree. b) Delete an element from a AVL tree. c) Search for a key element in a AVL tree.</td></tr>
<tr><td colspan="2">Course Outcomes as per Bloom's Taxonomy</td></tr>
<tr><td colspan="2">At the end of the course student will be able to:</td></tr>
<tr><td>CO 1</td><td>Use and implement[3] appropriate data structure for the required problems using aprogramming language such as C/C++.</td></tr>
<tr><td>CO 2</td><td>Analyze[3] step by step and develop algorithms to solve real world problems.</td></tr>
<tr><td>CO 3</td><td>Implement[3] various data structures viz. Stacks, Queues, Linked Lists, Trees andGraphs.</td></tr>
<tr><td>CO 4</td><td>Understand[2] various searching & sorting techniques.</td></tr>
<tr><td>CO 5</td><td>To apply[3] the learned concepts in various domains like DBMS and CompilerConstruction.</td></tr>
<tr><td>Text Books</td><td>• Horowitz Ellis and Sahani Sartaj: Fundamentals of Data Structures, New Delhi: Galgotia Publication
• Kruse R. L. , Leary, Tondo B. P. C. L. : Data Structure and Program Design in C:
• PHI.
• Tenenbaum Aaron, Yedidyah M, Langsam and Moshe Augenstein J. : DataStructures Using C and C++, New Delhi: PHI Publications.</td></tr>
<tr><td>Reference Books</td><td>• Trembley Jean Paul and G. Sorenson. Paul: An Introduction to Data Structures with applications, Noida: McGraw Hill Publications
• R. Kruse et. al.: Data Structures and Program Design in C,U. K. : Pearson Education
• Lipschutz. : Data Structures Schaum's Outline Series,New Delhi: TMH</td></tr>
</table>

COURSE CODE	JAVA PROGRAMMING	Theory: 30 Tutorial: 15 Practical: 15
CS20B303		(LTP=2-2-2=4)

Course Objectives:

To introduce and understand students to programming concepts and techniques using the Java language and programming environment, class, objects, and their relationships also learn about lifetime, scope and the initialization mechanism of variables and improve the ability general problem-solving abilities in programming. Be able to use the Java SDK environment to create, debug and run Java programs and able to develop software for solving problems.

UNIT	CONTENTS	HOURS
I	Basics of JAVA: Features of Java, JDK, JRE, JVM, variables, data types, Unicode system, operators, keywords, Control statements: if else, switch, for loop, while, dowhile, break, continue, comments, Classes and Objects: class, objects, methods, constructor, Inheritance, polymorphism, abstraction, encapsulation, Array, Packages, Modifiers, interface.	5
II	String: String class methods, StringBuffer class, StringBuilder class, Immutable class, StringTokenizer class, Java Regex, Wrapper class, Exception Handling: Try-catch block, finally block, throw and throws keyword. File handling: introduction, character Oriented Streams, Byte oriented stream, Writing and reading operations on file, File class Serialization, Deserialization	6
III	Multithreading: Thread States, Priorities and Thread Scheduling, Life Cycle of a Thread, Thread Synchronization, Creating andExecuting Threads, Multithreading with GUI, Monitors and Monitor Locks. Nested Classes: Introduction, Advantages of nested classes, Nestedclasses vs inner classes, Normal Inner classes, Method local inner classes, Anonymous inner classes, Static nested classes, Functional interfaces & lambda expressions, Annotations.	6
IV	Java Collective Frame Work - Data Structures: Introduction, Type- Wrapper Classes for Primitive Types, Dynamic Memory Allocation, Linked List, Stack, Queues, Trees, Generics: Introduction, Overloading Generic Methods, Generic Classes, Collections: Interface Collection and Class Collections, Lists, Array List and Iterator, Linked List, Vector. Collections Algorithms: Algorithm sorts, Algorithm shuffle, Algorithms reverse, fill, copy, max and min Algorithm binary Search, Algorithms add All, Stack Class of Package java. Util, Class Priority Queue and Interface Queue, Maps, Properties Class, Un-modifiable Collections.	7
V	Networking: Introduction, Socket and Server Socket, URL info, Client- Server programming. AWT(Abstract Window Tool Kit): Introduction, Frame class, Different layouts, Components of AWT (TextField, Radio Button, Checkbox…. etc), Event Handling or Event delegation Model, Different types of Listeners. Swings: Difference between Awt and swings, Advantages of swings, Different components of Swings (Text Field, Radio Button, Checkbox…. etc), Event handling in Swings. JDBC(java database connectivity)	6

List of Program: (expandable)

1. Installation of J2SDK
2. Write a program to show Scope of Variables
3. Write a program to show Concept of CLASS in JAVA
4. Write a program to show Type Casting in JAVA
5. Write a program to show How Exception Handling is in JAVA
6. Write a Program to show Inheritance
7. Write a program to show Polymorphism
8. Write a program to show Access Specifiers (Public, Private, Protected) in JAVA
9. Write a program to show use and Advantages of CONTRUCTOR
10. Write a program to show Interfacing between two classes
11. Write a program to Add a Class to a Package
12. Write a program to show Life Cycle of a Thread
13. Write a program to demonstrate AWT.
14. Write a program to Hide a Class
15. Write a Program to show Connectivity using JDBC
16. Write a program to demonstrate multithreading using Java.

Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO1	**Identify**[3] classes**,** objects**,** members of a class and relationships among them needed for a specific problem.
CO2	**Solve**[3] exception related problems and also able to handle and store data indifferent types of files.
CO3	**Apply**[3] suitable type of data structures to solve problems.
CO4	**Develop**[3] programs/software working in parallel and utilize maximum CPU time.
CO5	**Develop**[3] software/programs networking based and store data for further uses.
Text Books	• Schildt Herbert (2017): **Java The Complete Reference**, 8th edition,New Delhi: TMH. • Sierra Kathy & Bates Bert (2005): **Head First Java**, 2nd Edition, California: O'Reilly. • E. Balaguruswamy (2008): **Programming with Java A Primer,**3rd Edition,New Delhi: TMH.
Reference Books	• Deitel Harvey M. & Deitel Paul(2000): **JAVA, How to Program,**3rd Edition,U. S. : ,PHI**,** Pearson. • Hughes S. Merlin (1999): **Java Network Programming,**2nd Edition, New York: Manning Publications/Prentice Hall.

COURSECODE	PROJECT BASED LEARNING-III	Practical: 30
PB20B301		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
- For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks.
- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
  - Introduction
  - Review of literature
  - Methodology
  - Result and Discussion
  - Conclusion and Project Outcomes
  - References
- Student will need to submit three copies for
  - Concerned School
  - Central Library
  - Self
- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

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Department of Advanced Computing

wef 2024-25

COURSE CODE	QUANTITATIVE APTITUDE-II	Total Lecture: 30
UC20B402		(LTP=2-0-0=2)

Course Objectives

This course will enable students to

- Enhance the problem-solving skills
- Improve the basic mathematical skills.
- Enable students to manage the placement challenges more effectively

UNIT	CONTENTS	HOURS
I	Time & Distance, Problem on Trains, Boats & Streams Simple Interest, Compound Interest, Stocks & Shares, True Discount	6
II	Area, Volume & Surface Area, Permutation & Combination, Race & Game of Skill, Calendar, Clock, Probability	6
III	Data Interpretation: Tabulation, Bar Graphs, Pie chart & Line Graphs, Information Ordering, Information Processing Engineering Mathematics- Logarithms, Permutation and Combinations, Probability	6
IV	Exploratory Analysis- Design of experiments, Sampling, Sampling Error, Sampling Bias, Measures of CentralTendency and Dispersion, Statistical survey and Presentation of data, Statistical Inference	6
V	Correlation, Formulating Null & Alternate Hypothesis, Type I and Type II errors, Regression, z-test/t-test, p-value	6

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO1	Make **decisions**[5] based on analysis and critique of quantitative information using proportional reasoning. Students will also effectively justify and communicate their conclusions in ways appropriateo the audience.
CO2	**Solve**[3] real-life problems requiring interpretation and comparison of variouse presentations of ratios (i. e., fractions, decimals, rates, and percentages):
CO3	**Analyze**[4] and critique mathematical models and be able to describe their imitations
CO4	**Apply**[3] probabilistic reasoning to draw conclusions, to make decisions, and to evaluate outcomes of decisions.
CO5	**Distinguish**[4] between proportional and non-proportional situations and, whenappropriate, apply proportional reasoning.
Text Books	• Aggarwal RS . (2020): **Quantitative Aptitude for Competitive Exams**, **II** Edition New Delhi: S. Chand Publication • Gupta D P & Burnwal. (2020): **General Quantitative Aptitude for Competitive Exams**, **II** Edition Disha Publication

COURSE CODE	OBJECT ORIENTED ANALYSIS & DESIGN	Theory: 30 Tutorial: 15 Practical: 15
CS20B401		(LTP=2-2-2=4)

Course Objectives:

- To Understand the Object Oriented Life Cycle
- To Know how to identify Objects, Relationships, Services and Attributes through UML
- To Understand the Use case Diagram
- To Know the Object Oriented Design Process
- To Know about Software Quality and Usability

Unit	Contents	Hours
I	Introduction to UML, Importance of Modeling, Principles of Modeling, Object oriented modeling, Conceptual model of the UML, Architecture ofUML, Software Development Life Cycle.	6
II	Basic Structural Modeling, Classes, Relationships, Common Mechanisms, Basic Diagrams, Advanced Structural Modeling, Advanced Classes, Advanced Relationships, Interfaces, Types and Roles, Packages. Class andObject Diagrams, Terms, Concepts, Modeling Techniques for Class Diagrams	6
III	Basic Behavioral Modeling-I, Interactions, Interaction Diagrams. Basic behavioral Modeling-II, Use cases, Use case Diagrams, ActivityDiagrams.	6
IV	Advanced Behavioral Modeling, Events and Signals, State Machines, Processes and Threads, Time and Space, State Chart Diagrams.Architectural Modeling, Component, Deployment, Component Diagrams, Deployment Diagram.	6
V	Case Study, The Unified Library application	6

List of Experiments:

1. Library Management System
2. Point of Sale
3. E-Commerce web portal
4. Online Banking web portal
5. Online Travel Ticket Booking Portal
6. Online Hotel Booking portal
7. Hospital Management System
8. e-Governance portal
9. Content Management System
10. Web Counseling portal

COURSE OUTCOMES

At the end of the course the students will be able to:

CO 1	**Understand**[2] Unified Modelling Language and Rational Rose for object orientedmodelling
CO 2	**Illustrate**[2] the conceptual model of UML & Represent Behavioral diagrams in UML
CO 3	**Identify**[2] the basic and advanced structural diagrams
CO 4	**Relate**[3] forward and reverse engineering for a software system
CO 5	**Assess**[6] the architectural modelling of UML
Text Books	• Page Meilir, Jones. (2000): **Fundamentals of Object Oriented Design in UML,** India: Pearson Education. Kahate Atul. (2018): **Object Oriented Analysis & Design,** New Delhi: The McGraw-HillCompanies
Reference Books	• Booch Grady, Rumbaugh James and Jacobson Ivar, **The Unified ModelingLanguage User Guide,** 1st Edition, Addison Wesley. Bahrami Ali, **Object Oriented Systems Development using the unified modelinglanguage,** 1st Edition, Noida: Tata Mcgraw Hills Education.

COURSECODE	DATABASE MANAGEMENT SYSTEM	Total Lecture: 60 Theory: 45 Practical: 15
CS20B403		(LTP=3-0-2=4)

Course Objectives:

- To Understand the basic concepts and the applications of database systems
- To Master the basics of SQL and construct queries using SQL
- To understand the relational database design principles
- To become familiar with the basic issues of transaction processing and concurrencycontrol
- To become familiar with database storage structures and access techniques

UNIT	CONTENTS	HOURS
I	**Data base System:** Applications, Purpose of Database Systems, View of Data, Data Abstraction, Instances and Schemas, data Models, the ER Model, Relational Model, Other Models, Database Languages, DDL, DML, database Access for applications Programs, data base Users and Administrator, Transaction Management, data base Architecture, Storage Manager, the Query Processor Data base design and ER diagrams, ER Model, Entities, Attributes and Entity sets, Relationships and Relationship sets, ER Design Issues, ConceptDesign, Conceptual Design for University Enterprise, Introduction to the Relational Model, Structure, Database Schema, Keys, Schema Diagrams	9
II	**Relational Query Languages:** Relational Operations. Relational Algebra, Selection and projection set operations, renaming, Joins, Division, Examples of Algebra overviews, Relational calculus, Tuple relationalCalculus, Domain relational calculus. Overview of the SQL Query Language, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, GROUPBY, HAVING, Nested Sub queries, Views, Triggers.	9
III	**Normalization:** Introduction, Non loss decomposition and functionaldependencies, First, Second, and third normal forms, dependency preservation, Boyee/Codd normal form. Higher Normal Forms, Introduction, Multivalued dependencies and Fourth normal form, Join dependencies and Fifth normal form.	9
IV	**Transaction Concept:** Transaction State, Implementation of Atomicityand Durability, Concurrent, Executions, Serializability, Recoverability, Implementation of Isolation, Testing for serializability, Lock –Based Protocols, Timestamp Based Protocols, Validation, Based Protocols, Multiple Granularity. Recovery and Atomicity, Log, Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with loss of nonvolatile storage, Advance Recovery systems, Remote Backup systems.	9
V	**File organization:** File organization, various kinds of indexes. Query Processing, Measures of query cost, Selection operation, Projection operation, Join operation, set operation and aggregate operation, Relational Query Optimization, Transacting SQL queries, Estimating the cost, Equivalence Rules.	9

List of experiments:

1. Creating and Manipulating Database objects and Applying Constraints (DDL):
2. Manipulating Data with Database Objects (DML):
3. Retrieving, Restricting and Sorting Data (DRL):
4. SQL Single Row Functions
5. SQL Multiple Row Functions (Aggregate Function):
6. Displaying Data from Multiple Tables (Join):
7. Using Commit and Rollback show Transaction ACID Property.
8. Securing data using Views and Controlling User Access (DCL):
9. Write a join query based on two tables and analyse the query using action planAnd AuditTrails.
10. PL/SQL Block Syntax and DML Operation through PL/SQL Block.
11. Control Structures in PL/SQL.
12. Working with Cursor.
13. Creating Procedures and Functions in PL/SQL.
14. Creating Database Triggers.
15. Database Recovery Scenarios using Recovery Manager (RMAN):

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Demonstrate**[2] the basic elements of a relational database management system
CO 2	**Identify**[4] the data models for relevant problems
CO 3	**Design**[6] entity relationship and convert entity relationship diagrams into RDBMS
CO 4	**Formulate**[5] SQL queries on the respect data
CO 5	**Apply**[3] normalization for the development of application software's.
Text Books	• Silberschatz**,** Korth. (2011): **Data base System Concepts,** Sixth Edition**,**New Delhi: McGraw hill. • Raghurama Krishnan**,** Johannes Gehrke**: Database Management Systems,** 3rd Edition**,** New Dehli: McGraw hill.
Reference Books	• Navathe Elmasri**: Fundamentals of Database Systems,** New Dehli: Pearson Education. • Date C. J.**,** Kannan A.**,** Nadhan S. Swami**: An Introduction to Database systems,** Eight Edition**,** New Delhi: Pearson Education.

COURSE CODE	COMPUTER ORGANIZATION AND ARCHITECTURE	Total Lecture Theory: 45
CS23B404		(LTP=3-0-0=3)

Course Objectives:

- The objective of this course is to introduce the organization of a computer and its principalcomponents.
- The course will also enable the student to understand the design components of a digitalsubsystem.
- To understand the memory organization of computer.
- To understand the importance of Computer Arithmetic.
- To know the integrated role of computers and its components.
- To understand the process model of computer

UNIT	CONTENT	HOURS
I	**Basic Structure of Computer:** Structure of Desktop Computers, CPU: General Register Organization-Memory Register, Instruction Register, Control Word, Stack Organization, Instruction Format, ALU, I/O System, bus, CPU and Memory Program Counter, Bus Structure, Register Transfer Language-Bus and Memory Transfer, addressing modes. Control Unit Organization: Basic Concept of Instruction, Instruction Types, Micro Instruction Formats, Fetch and Execution cycle, Hardwired control unit, Microprogrammed Control unit microprogram sequencer Control Memory, Sequencing and Execution of Micro Instruction	6
II	Computer Arithmetic: Addition and Subtraction, Tools Compliment Representation, Signed Addition and Subtraction, Multiplication and division, Booths Algorithm, Division Operation, Floating Point Arithmetic Operation, design of Arithmetic unit	6
III	I/O Organization: I/O Interface –PCI Bus, SCSI Bus, USB, Data Transfer: Serial, Parallel, Synchronous, Asynchronous Modes of Data Transfer, Direct Memory Access(DMA), I/O Processor.	6
IV	Memory Organization: Main memory-RAM, ROM, Secondary Memory – Magnetic Tape, Disk, Optical Storage, Cache Memory: Cache Structure and Design, Mapping Scheme, Replacement Algorithm, Improving Cache Performance, Virtual Memory, memory management hardware.	6
V	Multiprocessors: Characteristics of Multiprocessor, Structure of Multiprocessor-Inter processor Arbitration, Inter-Processor Communication and Synchronization. Memory in Multiprocessor System, Concept of Pipelining, Vector Processing, Array Processing, RISC And CISC, Study of Multicore Processor –Intel, AMD.	6

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Understand**[2] theory of Digital Design and Computer Organization to provide aninsight of how basic computer components are specified.
CO 2	**Understand**[2] the functions of various hardware components and their building blocks.
CO 3	**Understand**[2] and appreciate Boolean algebraic expressions to digital design
CO 4	**Apply**[3] different combinational / sequential circuits.
CO 5	**Compare**[4] and Understand memory hierarchy and design of primary memory.
Text Books:	• Mano Morris: Computer System Organization 3rd Edition, India: PHI. • Ghosal Subrata. (2011): Computer Architecture and Organization, India: Pearson.
Reference Books:	• Usha M., Shrikant T. S. (2012): Computer System Architecture and Organization, India: Willey. • Sarangi. (2017): Computer Organization and Architecture, New Dehli: McGraw hill.

COURSECODE	PROJECT BASED LEARNING-IV	Practical: 30
PB20B401		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
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- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
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- Student will need to submit three copies for
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- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

V Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

Course Code	Introduction to Management & Leadership	Theory Lectures: 30
UC20B501		2-0-0-2

Course Objectives:

1. To introduce the students to the basic concepts and function of management.
2. To establish concept of the planning and decision-making process.
3. To understand the organizing process, structure and principle of business.
4. To apply the knowledge of directing and communication to solve complex business problems.
5. To analyze the skills, qualities, traits and styles of Leaders.

Units	Contents	Hours
1.	Introduction: Concept, Significance and Nature of Management and Leadership, Management Process, Management and Administration, Functions and Principles of Management, Levels of Management, Functional areas of Management and Leaders.	8
2.	Planning and Decision Making: Concept and Nature of planning, Objectives and Components of planning, Nature and Process of planning. Process of Planning, Dimensions / Types of Planning, Tools and Techniques of planning. Decision-Making – Nature, Significance and Process, Techniques of decision making.	7
3.	Organizing: Concept, Importance and Elements of Organization, Process and Principles of organization, Theories of Organization, Organization structure, Organization charts and manuals.	5
4.	Directing and Communication: Concept, Nature, Scope, Principles and Techniques of direction, Concept and Process of communication, Channel/Media of communication, Barriers to effective communication. Controlling: Concept, Objectives, Process and Principles of control, Various control technique.	5
5.	Leadership –Leadership Qualities, Traits and Personalities, Leadership Skills, Leadership Styles - Theories of Leadership – Trait Theory, Behavioral Theory, Fiedler's Contingency Models. Leaders as Change agent and Visionary, Leadership & culture, Ethics and Conflicts.	5

Course Outcomes

At the end of the course student would be able to:

CO1	Identify concepts of management and its importance in the various areas of the business.
CO2	Demonstrate interactive use of planning and decision making.
CO3	Obtain an understanding of the organizing process, structure and principle of business.
CO4	Apply the knowledge of directing and communication to solve complex business problems.
CO5	Be able to use analytic skills in addressing business problems using various Leadership styles.

Books:

Text Books	• Durai, P. (2015). Principles of Management, Text and Cases. New Delhi: Pearson Education. • Luthans, F. (2010). Organizational Behaviour. New York: McGraw-Hill. • L.M. Prasad, Principles & Practices of Management, Sultan Chand, 2010.
Reference Books	• Stoner, Freeman & Gilbert Jr. (2009). Management. New Delhi: Prentice Hall. • Weihrich, H. & Koontz, H. (2010). Management- A Global Perspective: New Delhi: Tata McGraw-Hill Education. • Robbins, S.P. & Decenzo, D. A. (2014). Fundamentals of Management: Essential Concepts and Applications. New Delhi: Pearson Education.

COURSE CODE	COMPUTER NETWORKS	Total Lecture:60 Theory:30 Tutorial:15 Practical:15
CS20B501		(LTP=2-2-2=4)

Course Objectives:

1. To develop an understanding of computer networking basics.
2. To develop an understanding of different components of computer networks
3. To understand various protocols, modern technologies and their applications.
4. Understand the services of network layer, transport layer and application layer.
5. Understand the concepts of data communication and networks, TCP/IP and OSI reference models.

UNIT	CONTENTS	HOURS
I	Computer Network: Definitions, goals, components, Architecture, Classifications & Types. Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, Connection Oriented & Connectionless Services, Service primitives, Design issues & its functionality. ISO-OSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations	10
II	Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary & Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP	7
III	MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and SlottedALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), Collision Free Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.	10
IV	Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least Cost Routing algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing, Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding, Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6	8
V	Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, Carrying Unicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of Data Transfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP Timer Management. Session layer: Authentication, Authorization, Session layer protocol (PAP, SCP, H.245). Presentation layer: Data conversion, Character code translation, Compression, Encryption and Decryption, Presentation layer protocol (LPP, Telnet, X.25 packet Assembler/Disassembler).Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).	10

List of Experiments:

1 Study of Different Type of LAN & Network Equipments.
2. Study and Verification of standard Network topologies i.e. Star, Bus, Ring etc.
3. LAN installations and Configurations.
4. Write a program to implement various types of error correcting techniques.
5. Write a program to Implement various types of framing methods.
6. Study of Tool Command Language (TCL).
7. Study and Installation of Standard Network Simulator: N.S-2, N.S-3.OpNet,QualNet etc .
8. Study & Installation of ONE (Opportunistic Network Environment) Simulator for High Mobility Networks .
9. Configure 802.11 WLAN.
10. Implement & Simulate various types of routing algorithm.
11. Study & Simulation of MAC Protocols like Aloha, CSMA, CSMA/CD and CSMA/CA using Standard Network Simulators.
12. Study of Application layer protocols- DNS, HTTP, HTTPS, FTP and TelNet

COURSE OUTCOMES

At the end of the course student will be able to:

CO1	**Describe** the functions of each layer in OSI and TCP/IP model.
CO2	**Explain** the functions of Application layer and Presentation layer paradigms and Protocols
CO3	**Describe** the Session layer design issues and Transport layer services.
CO4	**Model** a problem or situation in terms of layering concept and map it to the TCI/IP stack

CO5	**Classify** the routing protocols and analyze how to assign the IP addresses for the given network
Text Books	• Tanenbaum A. S ,"Computer Networks "Pearson Education. • Stalling W, "Computer Networks", Pearson Education • Douglas E. Comer & M.S Narayanan,"Computer Network & Internet", Pearson Education • Prakash C. Gupta, "Data Comunications and Computer Networks", PHI • Bertsekas & Gallager "Data Network" , PHI • Gallo,"Computer Communication & Networking Technologies",Cengage Learning
Reference Books	• Behraj A Forouzan,"Data Communication & Networking", McGraw-Hill. • Natalia Olifar& Victor Olifer,"Computer Networks", Willey Pub.

COURSE CODE	THEORY OF COMPUTATION	Total Lecture :60 Theory :45 Tutorial :15
CS20B502		(LTP=3-2-0=4)

Course Objectives:

- The course begins with the basic mathematical preliminaries and goes on to discuss the general theory of automata.
- To learn properties of regular sets and regular expressions, and the basics of formal languages.
- To learn pushdown automata and its relation with context free languages.
- To learn Turing machines and linear bounded automata.
- The basic concepts of computability such as primitive recursive functions and partial recursive functions.

UNIT	CONTENTS	HOURS
I	Introduction of Automata Theory: Examples of automata machines, Finite Automata as a language acceptor and translator, Moore machines and mealy machines, composite machine, Conversion from Mealy to Moore and vice versa.	10
II	Types of Finite Automata: Non Deterministic Finite Automata (NDFA), Deterministic finite automata machines, conversion of NDFA to DFA, minimization of automata machines, regular expression, Arden's theorem. Meaning of union, intersection, concatenation and closure, 2 way DFA.	10
III	Grammars: Types of grammar, context sensitive grammar, and context free grammar, regular grammar. Derivation trees, ambiguity in grammar, simplification of context free grammar, conversion of grammar to automata machine and vice versa, Chomsky hierarchy of grammar, killing null and unit productions. Chomsky normal form and Greibach normal form.	10
IV	Push down Automata: example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model.	8
V	Turing Machine: Techniques for construction. Universal Turing machine Multitape, multihead and multidimensional Turing machine, N-P complete problems. Decidability and Recursively Enumerable Languages, decidability, decidable languages, undecidable languages, Halting problem of Turing machine & the post correspondence problem.	7

COURSE OUTCOMES

At the end of the course student will be able to:

CO 1	**Explain**[1] the models of computation, including formal languages, grammars and automata, and their connections.
CO 2	**Discuss**[2] key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity through problem solving.
CO 3	**Analyze**[4] the grammar, its types, simplification and normal form.
CO 4	**Analyze**[4] and design finite automata, pushdown automata, Turing machines, formal languages and grammars.
CO5	**Develop**[6] an overview of how automata theory, languages and computation are applicable in engineering application.
Text Books	• Hopcroft and Ullman (2007): **Introduction to Automata Theory, Languages, and Computation:** Addision Wesley, 3rd Edition . • Linz P.(2013): **Formal Languages And Automata Theory:** Noida, Pearson Education India, 4th Edition.
Reference Books	• Mishra KLP, Chandrasekaran N. (2008): **Theory of Computer Science:** PHI Learning Pvt. Ltd. Pandey (2013): • **Introduction to Automata Theory & Formal Languages:**Delhi: S.K. Kataria & Sons. Publication.

COURSE CODE	ANALYSIS AND DESIGN OF ALGORITHMS	Total Lecture:60 Theory:45 Practical:15
CS20B503		(LTP=3-0-2=4)

Course Objectives:
Obtaining efficient algorithms is very important in modern computer engineering as the world wants applications to be time and space and energy efficient. This course enables to understand and analyze efficient algorithms for various applications.

UNIT	CONTENTS	HOURS
I	**INTRODUCTION:** Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation, theta notation and little (o) notation, recurrences, probabilistic analysis, disjoint set operations, union and find algorithms.	10
II	**DIVIDE AND CONQUER**: General method, applications-analysis of binary search, quick sort, merge sort, AND OR Graphs. **GREEDY METHOD**: General method, Applications-job sequencing with deadlines, Fractional knapsack problem, minimum cost spanning trees, Single source shortest path problem.	10
III	**GRAPHS (Algorithm and Analysis)**: Breadth first search and traversal, Depth first search and traversal, Spanning trees, connected components and bi-connected components, Articulation points. **DYNAMIC PROGRAMMING**: General method, applications - optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.	10
IV	**BACKTRACKING**: General method, Applications- n-queen problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles. BRANCH AND BOUND: General method, applications - travelling sales person problem, 0/1 knapsack problem- LC branch and bound solution, FIFO branch and bound solution.	8
V	**NP-HARD AND NP-COMPLETE PROBLEMS**: Basic concepts, non-deterministic algorithms, NP-hard and NP-complete classes, Cook's theorem.	7

List of Experiments:
1. Implementation and analysis of sorting algorithms. Bubble sort, Selection sort, Insertion sort, Merge sort and Quicksort
2. Implementation and Time analysis of linear and binary search algorithm.
3. Implementation of max-heap sort algorithm
4. Implementation and Time analysis of factorial program using iterative and recursive method
5. Implementation of a knapsack problem using dynamic programming.
6. Implementation of chain matrix multiplication using dynamic programming.
7. Implementation of making a change problem using dynamic programming
8. Implementation of a knapsack problem using greedy algorithm
9. Implementation of Graph and Searching (DFS and BFS).
10. Implement prim's algorithm
11. Implement kruskal's algorithm.
12. Implement LCS problem.

COURSE OUTCOMES

At the end of the course student will be able to:

CO 1	**Analyze**[3] the efficiency of algorithms using time and space complexity theory.
CO 2	**Understand**[2] the mathematical foundation in analysis of algorithms.
CO 3	**Understand**[2] different algorithmic design strategies.
CO 4	**Evaluate**[4] problems using algorithm design techniques such as backtracking and branch & bound.
CO5	Using the existing algorithms understand and **create**[5] solutions for various types of problems.
Text Books	• Ellis Horowitz, Satraj Sahni, Rajasekharam (2007), **Fundamentals of Computer Algorithms**, 2nd edition, University Press, New Delhi.
Reference Books	• R. C. T. Lee, S. S. Tseng, R.C. Chang and T. Tsai (2006), **Introduction to Design and Analysis of Algorithms A strategic approach**, McGraw Hill, India. • Allen Weiss (2009), **Data structures and Algorithm Analysis in C++**, 2nd edition, Pearson education, New Delhi. • Aho, Ullman, Hopcroft (2009), **Design and Analysis of algorithms**, 2nd edition, Pearson education,

	New Delhi

COURSECODE	PROJECT BASED LEARNING-V	Practical: 30
PB20B501		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
- For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks.
- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
  - Introduction
  - Review of literature
  - Methodology
  - Result and Discussion
  - Conclusion and Project Outcomes
  - References
- Student will need to submit three copies for
  - Concerned School
  - Central Library
  - Self
- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

VI Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	SOFTWARE ENGINEERING	Total Lecture:45 Practical:15
CS20B601		(LTP=3-0-2=4)

Course Objectives:

- To introduce software development life cycle and various software process models
- To introduce measures and metrics for software quality, reliability and software estimation techniques
- To develop an understanding of software analysis and design phases
- To introduce coding standards, guidelines and various software testing techniques
- To introduce various activities for software maintenance and quality assurance

UNIT	CONTENTS	HOURS
I	The Software Product and Software Process Software Product and Process Characteristics, Software Process Models: Linear Sequential Model, Prototyping Model, RAD Model, Evolutionary Process Models like Incremental Model, Spiral Model, Component Assembly Model, RUP and Agile processes. Software Process customization and improvement, CMM, Product and Process Metrics	10
II	Requirement Elicitation, Analysis, and Specification Functional and Non-functional requirements, Requirement Sources and Elicitation Techniques, Analysis Modeling for Function-oriented and Object-oriented software development, Use case Modeling, System and Software Requirement Specifications, Requirement Validation, Traceability	7
III	Software Design, The Software Design Process, Design Concepts and Principles, Software Modeling and UML, Architectural Design, Architectural Views and Styles, User Interface Design, Function oriented Design, SA/SD Component Based Design, Design Metrics	10
IV	Software Analysis and Testing Software Static and Dynamic analysis, Code inspections, Software Testing, Fundamentals, Software Test Process, Testing Levels, Test Criteria, Test Case Design, Test Oracles, Test Techniques, Black-Box Testing, White-Box Unit Testing and Unit, Testing Frameworks, Integration Testing, System Testing and other Specialized, Testing, Test Plan, Test Metrics, Testing Tools. , Introduction to Object-oriented analysis, design and comparison with structured Software Engg.	10
V	Software Maintenance & Software Project Measurement Need and Types of Maintenance, Software Configuration Management (SCM), Software Change Management, Version Control, Change control and Reporting, Program Comprehension Techniques, Re-engineering, Reverse Engineering, Tool Support. Project Management Concepts, Feasibility Analysis, Project and Process Planning, Resources Allocations, Software efforts, Schedule, and Cost estimations, Project Scheduling and Tracking, Risk Assessment and Mitigation, Software Quality Assurance (SQA). Project Plan, Project Metrics	8

COURSE OUTCOMES

At the end of the course student will be able to:

CO1	**Develop** an estimation of the cost, quality, and management issues involved in software construction
CO2	**Identify** and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.
CO3	**Develop** and apply testing strategies for software applications
CO4	**Develop** a thorough understanding of software development lifecycle principles
CO5	**Design** and plan software solutions to problems using an object oriented strategy
Text Books	• Fundamentals of Software Engineering, Rajib Mall, PHI, 2014. • Software Engineering, A Practitioner's Approach, Roger S. Pressman, TMG Hill.
Reference Books	• Software Engineering, I. Sommerville, 9th Ed. PearsonEducation. • Software Engineering, an Engineering approach- James F. Peters, WitoldPedrycz, John Wiley. • Software Engineering principles and practice- Waman S Jawadekar, The McGraw-Hill Companies. • Fundamentals of object-oriented design using UML Meiler page-Jones: Pearson Education.

COURSE CODE	COMPILER DESIGN	Total Lecture:45 Practical:15
CS23B602		(LTP=3-0-2=4)

Course Objectives:

- To implement Lexical Analyzer using Lex tool & Syntax Analyzer or parser using YACC Tool
- To implement NFA and DFA from a given regular expression
- To implement front end of the compiler by means of generating Intermediate codes.
- To implement code optimization techniques

UNIT	CONTENTS	HOURS
I	Introduction to Compiler: Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG	10
II	Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables	7
III	Syntax-directed Translation: Syntax-directed Translation schemes, Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements	10
IV	Symbol Tables: Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.	10
V	Code Generation: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	8

COURSE OUTCOMES

At the end of the course student will be able to:

CO1	Acquire knowledge of different phases and passes of the compiler and also able to **use**[3] the compiler tools like LEX, YACC, etc. Students will also be able to **design**[6] different types of compiler tools to meet the requirements of the realistic constraints of compilers.
CO2	**Understand**[2] the parser and its types i.e. Top-Down and Bottom-up parsers and **construction**[6] of LL, SLR, CLR, and LALR parsing table.
CO3	**Implement**[5] the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes
CO4	**Acquire**[2] knowledge about run time data structure like symbol table organization and different techniques used in that
CO5	**Understand**[2] the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.
Text Books	• Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education • K. Muneeswaran,Compiler Design,First Edition,Oxford University Press
Reference Books	• J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill,2003. • Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001. • V Raghvan, " Principles of Compiler Design", McGraw-Hill

COURSECODE	PROJECT BASED LEARNING-VI	Practical: 30
PB20B601		(LTP=0-0-4=2)

Course Objectives:

- Integrating the knowledge and skills of various courses on the basis of multidisciplinary projects
- Develop the skill of critical thinking and evaluation.
- To develop 21st century success skills such as critical thinking, problem solving, communication, collaboration and creativity/innovation among the students.
- To enhance deep understanding of academic, personal and social development in students.
- Employ the specialized vocabularies and methodologies.

General Guidelines:

- PBL will be an integral part of UG/PG Programs at different levels.
- Each semester offering PBL will provide a separate Course Code, two credits will be allotted to it.
- Faculty will be assigned as mentor to a group of 30 students minimum byHoS.
- Faculty mentor will have 4 hours/week to conduct PBL for assigned students.
- Student will select a topic of their choice from syllabus of any course offered in respective semester (in-lines with sustainable development goals):
- Student may work as a team maximum 3 or minimum 2 members for single topic.
- For MSE, student's performance will be assessed by panel of three experts either from other department/school, or from samedepartment/school based on chosen topic. This will be comprised of apresentation by student followed by viva-voce. It will be evaluated for 30 marks.
- 20 marks would be allotted for continuous performance assessment by concerned guide/mentor.
- For ESE, student will need to submit a project report in prescribed format, duly signed by concerned guide/mentor and head of the school. The report should be comprised of following components:
  - Introduction
  - Review of literature
  - Methodology
  - Result and Discussion
  - Conclusion and Project Outcomes
  - References
- Student will need to submit three copies for
  - Concerned School
  - Central Library
  - Self
- The integrity of the report should be maintained by student. Any malpractice will not be entertained.
- Writing Ethics to be followed by student, a limit of 10 % plagiarism ispermissible. Plagiarism report is to be attached along with the report.
- Project could be a case study/ analytical work /field work/ experimentalwork/ programming or as per the suitability of the program.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Apply**[3] a sound knowledge/skill to select and develop their topicand project respectively.
CO 2	**Develop**[6] plans and allocate roles with clear lines of responsibilityand accountability.
CO 3	**Design**[6] solutions to complex problems following a systematicapproach like problem identification, formulation and solution.
CO 4	**Collaborate**[6] with professionals and the community at large inwritten and in oral forms
CO 5	**Correlate**[4] the knowledge, skills and attitudes of a professional.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

VII Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	SUMMER INTERNSHIP PROJECT	Duration: 04 Weeks
CS20B703		(LTP=0-0-8=4)

Learning Objective:

- Integrating the knowledge and skills gain through industry exposure.
- Develop the skills of critical thinking and evaluation.
- To make students to learn themselves by choosing the internship as per there area of interest.

General Guidelines:

STUDENT'S DIARY

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit. Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria: • Regularity in maintenance of the diary. • Adequacy & quality of information recorded. • Drawings, sketches and data recorded. • Thought process and recording techniques used. • Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate observations and learning in the training period. The student may contact Industrial Supervisor/ Faculty Mentor for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, CPDD and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria: i. Originality. ii. Adequacy and purposeful write-up. iii. Organization, format, drawings, sketches, style, language etc. iv. Variety and relevance of learning experience. Practical applications, relationships with basic theory and concepts taught in the course.

INTERNAL EVALUATION OF INTERNSHIP

Evaluation by faculty supervisor on the basis of internship report/report received by industry.

EXTERNAL EVALUATION OF INTERNSHIP

Evaluation through seminar presentation/viva-voce at the Institute by external examiner.

COURSE CODE	MINOR PROJECT	Total Hours: 16
CS20B704		(LTP=0-0-16=8)

Learning Objective:

- Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.
- In contrast to the majority of courses studied elsewhere in the program, projects are undertaken individually or in small groups. This necessarily introduces the dimension of workload management into the program to enable completion of a large, relatively unstructured "assignment" over the course of the semester.
- The projects undertaken span a diverse range of topics, including theoretical, simulation and experimental studies, and vary from year to year. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

General Guidelines:

All the students of VII Semester are required to submit a project report based on the work done by him/her during the project period.

THE GUIDE

Each of the student/group will be assigned a faculty member as project guide with due approval from the HOS.

PROJECT TIME / MAN-HOURS

- The Minor Project would be 16 man-hours per week carries a total of 200 marks.
- The Project topic should be based on syllabus or as per the requirement of specific industry in sync with the course.
- Every group of students has to prepare and submit the project work separately.
- Plagiarism would not be accepted under any circumstances.
- Project Report should compulsorily include the software development; soft copy should also be submitted in CD along with Spiral Bound Project report.

PROJECT EVALUATION GUIDELINES

The project is evaluated on the basis of following aspects:
Presentation - 25% of total marks.
Project report - 30% of total marks.
Demonstration - 10% of total marks.
Methodology - 15% of total marks.
Viva - 20% of total marks.
Passing criteria is 50% of overall marks allotted to the project

COURSE OUTCOMES AS PER BLOOM'S TAXONOMY

At the end of the course the students should be able to:

CO1	**Identify**[2] and **Analyze**[4] a problem domain.
CO2	**Design**[6] engineering solutions to complex problems utilizing a systems approach.
CO3	**Define**[2] and identify various migrating strategies that can be used for a given scenario.
CO4	**Apply**[3] and undertake problem identification, formulation and solution.
CO5	**Demonstrate**[3] a sound technical knowledge of their selected project topic.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

VIII Semester

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	MOOC	Total Hours:40
MO20B80X		(LTP=0-0-8=4)

Learning Objective:

- Integrating the knowledge and skills of various courses available in online mode.
- Develop the skills of critical thinking and evaluation.
- To make students to learn themselves by choosing the course as per there area of interest.

General Guidelines:

- This course creates an excellent opportunity for students to acquire the necessary skill set for research, employability through massive open online courses (MOOCs) where the rare expertise of world-famous experts from academics and industry are available.
- The basket for MOOCs will be a dynamic one, as courses keep on updating with time (Preferable NPTEL/SWAYAM Courses).
- In this semester 8 credits will have to be acquired with online courses (MOOCs). Students will have to complete 2 MOOCs of their choice in the VII Semester.
- Each MOOC carries internal marks of 50, which will be attained after he/she gets the MOOC certificate for which he/she got himself/herself enrolled. For end sem evaluation a Viva-Voce examination shall be conducted and it will carry 50 marks.

COURSE CODE	MAJOR PROJECT	Total Hours: 32
CS20B801		(LTP=0-0-32=16)

Learning Objective:

- Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a thesis, and a public demonstration of work undertaken.
- In contrast to the majority of courses studied elsewhere in the program, projects are undertaken individually or in small groups. This necessarily introduces the dimension of workload management into the program to enable completion of a large, relatively unstructured "assignment" over the course of the semester.
- The projects undertaken span a diverse range of topics, including theoretical, simulation and experimental studies, and vary from year to year. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres.

General Guidelines:

All the students of VIII Semester are required to submit a project report based on the work done by him/her during the project period.

THE GUIDE

Each of the student/group will be assigned a faculty member as project guide with due approval from the HOS.

PROJECT TIME / MAN-HOURS

- The Minor Project would be 32 man-hours per week carries a total of 400 marks.
- The Project topic should be based on syllabus or as per the requirement of specific industry in sync with the course.
- Every group of students has to prepare and submit the project work separately.
- Plagiarism would not be accepted under any circumstances.
- Project Report should compulsorily include the software development; soft copy should also be submitted in CD along with Spiral Bound Project report.

PROJECT EVALUATION GUIDELINES

The project is evaluated on the basis of following aspects:
Presentation - 25% of total marks.
Project report - 30% of total marks.
Demonstration - 10% of total marks.
Methodology - 15% of total marks.
Viva - 20% of total marks.
Passing criteria is 50% of overall marks allotted to the project

COURSE OUTCOMES AS PER BLOOM'S TAXONOMY

At the end of the course the students should be able to:

CO1	**Identify**[2] and **Analyze**[4] a problem domain.
CO2	**Design**[6] engineering solutions to complex problems utilizing a systems approach.
CO3	**Define**[2] and identify various migrating strategies that can be used for a given scenario.
CO4	**Apply**[3] and undertake problem identification, formulation and solution.
CO5	**Demonstrate**[3] a sound technical knowledge of their selected project topic.

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

Discipline Specific Electives (DSE)
Artificial Intelligence

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	FOUNDATION TO ARTIFICIAL INTELLIGENCE, DATA SCIENCE AND MACHINE LEARNING	Total Lecture: 45 Practical: 15
AI23B101		(LTP=3-0-2=4)

Course Objectives:

- To learn about the Artificial Intelligence and its evolution
- To differentiate between different learning algorithms and analytics frameworks
- To understand different data science processes, tools and techniques
- To know the processes that are required to execute a data science project successfully
- To extract information from different data sets using Excel

UNIT	CONTENTS	HOURS
I.	Introduction to Data Science: Defining Data Science and Big Data, Benefits and Uses of Data Science and Big Data, Facets of Data, Structured Data, Unstructured Data, Natural Language, Machine generated Data, Graph based or Network Data, Audio, Image, Video, Streaming data, Data Science	10
II.	Process, Big data ecosystem and data science, distributed file systems, Distributed programming framework, data integration framework, machine learning framework, No SQL Databases, scheduling tools, benchmarking tools, system deployments	10
III.	Data Science Processes: Six steps of data science processes, define research goals, data retrieval, cleansing data, correct errors as early as possible, integrating – combine data from different sources, transforming data, exploratory data analysis, Data modelling, model and variable selection, model execution, model diagnostic and model comparison, presentation and automation.	9
IV.	Introduction to Machine Learning: What is Machine Learning, Learning from Data, History of Machine Learning, Big Data for Machine Learning, Leveraging Machine Learning, Descriptive vs Predictive Analytics, Machine Learning and Statistics, Artificial Intelligence and Machine Learning, Types of Machine Learning – Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Types of Machine Learning Algorithms, Classification vs Regression Problem, Bayesian, Clustering, Decision Tree, Dimensionality Reduction, Neural Network and Deep Learning, Training machine learning systems	8
V.	Introduction to Data Analytics: Working with Formula and Functions, Introduction to Power BI & Charts, Logical functions using Excel, Analyzing Data with Excel.	8

List of Experiments:

1. Experiment on Match function
2. Assignment on Covid Case study
3. Conditional formatting
4. Pivot Table
5. Power Map
6. Power Bi
7. Modelling
8. Sales Wallet transaction
9. Power Query
10. Correlation method

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Outline the key concepts of AI and how AI has evolved
CO 2	Identify the key concepts of Machine Learning and will be able to differentiate between key algorithms such as supervised learning and unsupervised learning
CO 3	Distinguish key Data Science concepts such as structured and unstructured data, SQL and NoSQL Database
CO 4	Examine the process required the successfully execute a Machine Learning or Data Science project
CO 5	Infer the large scale data using Excel
Text Books	• Artificial Intelligence 3e: A Modern Approach Paperback – By Stuart J Russell & Peter Norvig; Publisher – Pearson • Artificial Intelligence Third Edition By Kevin Knight, Elaine Rich, B. Nair – McGrawHill • Artificial Intelligence Third Edition By Patrick Henry Winston – Addison-Wesley Publishing Company

COURSE CODE	DATA ANALYSIS USING PYTHON	Total Lecture: 45 Practical: 15
AI23B201		(LTP=3-0-2=4)

Course Objectives:

- Understand the basic concepts of Python Programming
- Learn and practice the python programming data structure, functions, and file handling
- Use the multidimensional array objects in Numpy to statistical analyze the data
- Load the data into a pandas data frame and complete the data wrangling exercise
- Plot the graphs using matplotlib and seaborn

UNIT	CONTENTS	HOURS
I.	**Python programming Basic:** Python interpreter, IPython Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow.	10
II.	**Data Structure, functions, files:** tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems	10
III.	**NumPy: Array and vectorized computation:** Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array	9
IV.	**Pandas:** Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format	8
V.	**Visualization with Matplotlib:** Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration **Plotting with pandas and seaborn:** line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data	8

List of Experiments:

1. Write a Python program to find those numbers which are divisible by 7 and multiple of 5, between 1500 and 2700 (both included)?
2. Given the string 'Today is a sunny day.'
   - Write a code to get 'Today' and 'sunny'.
   - Obtain the last two letters.
   - Write the statement backwards.
3. Use list comprehension to obtain the squre root of first 10 natural numbers.
4. How to filter words that contain at least 2 vowels from a series?
   Ser = dearies([‘Apple’, ‘Orange’, ‘Plan’, ‘Python’, ‘Money’])
5. Write a code to find the first five rows and last five rows in dataset?
6. Using the list of tree names = ["Mango tree", "Coconut tree", "papaya tree", "Apple tree", "Banana tree", "Blackberry tree"] answer the below questions.
7. Write a program that asks the user to enter a string (consisting of any characters). Then create and print a dictionary from that string whose keys are the characters of the string and whose values are how many times those characters appear in the string.

   Sample Input/Output:

   Enter a string: AAABBCCCCC##**

   Characters with its count: {'*': 2, 'C': 5, '#': 2, 'B': 2, 'A': 3}

8. Create a pandas series having values 4, 7, -5, 3, NAN.
   - Set their index as d, b, a, c, e.
   - The minimum of all values.
   - The maximum of all value.
   - The values in ascending order.

- The values in descending order.

9. Create a 2D Numpy array from list of lists.
   List1 = [[110, 102, 183],[140, 175, 106], [170, 195, 117], [192, 140, 195]]
   - Find the minimum value along each of the rows.
   - Replace all odd numbers in the array with -2.
   - Swap row 1 and row 2 in the given array.
10. Write a code for the following:
    - Check whether input is even number or odd number (take input from the user).
    - Print whether a number is divisible by 9 and a multiple of 6 (take input from the user).
    - Retrieve the third element in the given list.

    num_list = [5, 3, 6, 1, 85, 23, 5, 13]

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate the understanding of basic concepts of Python Programming and IPython
CO 2	Apply the key python data structure such as list, dict, set, and tuple along with functions to clean data
CO 3	Utilize the Numpy multidimensional arrays to slice, and index the data
CO 4	Analyze the data using pandas data frame by loading data from system and build competency in data wrangling
CO 5	Examine the data by plotting graphs using matplotlib and seaborn
Text Books	• Achim Klenke, (2014), Probability Theory A Comprehensive Course Second Edition, Springer, ISBN 978-1-4471-5360-3 • Christian Heumann, Michael Schomaker Shalabh (2016), Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Springer International Publishing, ISBN 978-3-319-46160-1 • Douglas C. Montgomery, (2012), Applied Statistics and Probability for Engineers, 5th Edition, , Wiley India, ISBN: 978-8-126-53719-8

COURSE CODE	INTRODUCTION TO COMPUTATIONAL THINKING	Total Lecture: 45 Practical: 15
CS20B108		(LTP=3-0-2=4)

Course Objectives:

The aim of this course is hence to take students with no prior experience of thinking in a computational manner to a point where they can derive simple algorithms and code the programs to solve some basic problems in their domain of studies. In addition, the course will include topics to appreciate the internal operations of a processor, and raise awareness of the socio-ethical issues arising from the pervasiveness of computing technology.

UNIT	CONTENTS	HOURS
I.	Computer Networking: Introduction, Goals, ISO-OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Introduction to Internet, World Wide Web, E-commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking,, Logic bombs, Hacking Spamming, Cyber Defamation, pharming Security measures Firewall, Computer Ethics & Good Practices, Introduction of Cyber Laws about Internet Fraud, Good Computer Security Habits,	10
II.	CT concept – Abstraction, Decomposition, Pattern recognition, Algorithm, Limit of computing, Analysis of Algorithm Complexity, Space and time Complexity, code optimization.	10
III.	Human intelligence and artificial intelligence, introduction, Need of AI and its application. Introduction to Internet of thing, characteristics, benefits, hardware and its application. Introduction of Data science and its application. Cloud computing: definition, characteristics, service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public, private, community and hybrid clouds), Pros and Cons of cloud computing. Edge and Fog Computing, Quantum Computers. Introduction of Big Data and Hadoop.	9
IV.	Data base Management System: Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages	8
V.	Computer: Definition, Classification, Organization i. e. CPU, register, Bus architecture, Instruction set, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer Application in E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and Climatology, Computer Gaming, Multimedia and Animation etc. Operating System: Definition, Function, Types, Management of File, Process & Memory. Introduction to MS word, MS PowerPoint, MS Excel	8

List of Experiments:

1. Study and practice of Internal & External DOS commands.
2. Study and Practice of MS windows –Folder related operations, My-Computer, window explorer, Control Panel,
3. Creation and editing of Text files using MS-word.
4. Creation and operating of spreadsheet using MS-Excel.
5. Creation and editing power-point slides using MS-power point.
6. Study of the features of firewall in providing network security and to set Firewall Security in windows.
7. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
8. Connect the computers in Local Area Network.
9. Case Study of Google App Engine.
10. Case Study of Different internetworking devices.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Explain**[4] the internal operation of a basic processor, how a program is executed by a computer and computing trends.
CO 2	**Express**[2] basic programs based on the programming language used in the course.

CO 3	Formulate a problem and **express**[2] its solution in such a way that a computer can effectively carry it out. (i. e. equip you with CT skills)
CO 4	**Apply**[3] the CT concepts on case studies/problem-based scenarios through hands-on practice of the CT process.
CO 5	**Associate**[2] knowledge of Microsoft office suit and have hands on it.
Text Books	• Forouzan Behrouz A. (2007): **Data communication & networking,** fourth edition**,** Noida: MC Graw-Hill • Korth Henry F (1997): **Data base system concept,** 6th edition**,** Noida: McGraw-Hill Education. .
Reference Books	• Malhotra T D (2020): **New trends in computer,** 1st edition**,** Delhi: Evergreen Publications.

COURSE CODE	PROBABILISTIC MODELLING AND REASONING WITH PYTHON	Total Lecture: 45 Practical: 15
AI23B301		(LTP=3-0-2=4)

Course Objectives:

- Help student understand the importance and implementation of various random sampling techniques
- Describe probability and various probability distributions such as normal distribution, beta, gamma, students -t, and bivariate distributions
- Introduce the concepts of estimation techniques that covers both point and interval estimation
- Teach the concepts of hypothesis testing, p value, and Bayesian statistics

UNIT	CONTENTS	HOURS
I.	**Introduction to Statistics:** Introduction to Statistics. Role of statistics in scientific methods, current applications of statistics. **Scientific data gathering:** Sampling techniques, scientific studies, observational studies, data management. **Data description:** Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.	10
II.	**Probability Theory:** Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes' theorem. **Random Variables:** Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, Poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, $\chi^{"}$ distribution. Expectations, variance and covariance. Probability Inequalities. Bivariate distributions.	10
III.	**Point Estimations:** Methods of finding estimators, method of moments, maximum likelihood estimators, bayes estimators. Methods of evaluating estimators, mean squared error, best unbiased estimator, sufficiency and unbiasedness **Interval Estimations:** Confidence interval of means and proportions, Distribution free confidence interval of percentiles	9
IV.	**Test of Statistical Hypothesis and p-values**: Tests about one mean, tests of equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests **Bayesian Statistics:** Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean	8
V.	**Univariate Statistics using Python:** Mean, Mode. Median, Variance, Standard Deviation, Normal Distribution, t-distribution, interval estimation, Hypothesis Testing, Pearson correlation test, ANOVA F-test about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, history of AI	8

List of Experiments:

1. Tip collected at restaurant
    - Find out Five-Number summary for "Total Bill" and "Tip"
    - Plot the Box plot diagram for "Total Bill" and "Tip"
    - Analyze the diagram to mark the skewness in the data
    - Find out the outliers for "Total Bill" and "Tip"
    - Find out the IQR
    - Plot the histogram for "Total Bill" and "Tip"
    - Identify skewness in each. Type of skewness and the possible reason for the skewness
    - Plot the cumulative Frequency Polygon for "Total Bill" and "Tip"
    - Prepare the Frequency Table and Bar Chart for "Size". Summarize and explain your findings
    - Prepare two variable frequency tables for "Size" vs "Tip" and "Size" vs "Total Bill". Summarize and explain your findings.
    - Explore if there is any dependency between the variable "Tip" and rest of the variables
2. Conduct exploratory data analysis on sales of summer clothes dataset
3. Conduct exploratory data analysis on white wine quality data

4. Indian Premier League
    - Take the win_by_wickets dataset and plot frequency distribution graph
    - Relative frequency distribution graph using the same data set win_by_wickets
    - Plot Cumulative relative frequency graph
    - Find out the probability of winning a match by 6 wickets or less?
    - Find out the probability using the cumulative relative frequency graph
    - Plot the normal distribution for win_by_wickets data.
    - Calculate z-score if the team wins by 35 runs.
    - Calculate mean and standard deviation for win_by_wickets data
    - Calculate percentile using z-score.
5. Plotting of continuous and discrete distributions
6. Create Q-Q plot using distribution
7. Cryptocurrency Financial Data
    - Load the data
    - Print the head
    - Market Cap Column: Remove comma sign and store the values as integer
    - Calculate for nnlf using beta, norm , expon, gamma, uniform distributions
    - Plot the bar plot for showing distributions and nnlf
    - Print the distribution with minimum nnlf
8. Analysis of an alloy speciman – normal probability plot, calculate confidence interval
9. Check simple random condition and Sample size condition on annual cost of lease data

Analysis on payroll data

Course Outcome as per Bloom's Taxonomy	
At the end of the course the students will be able to**:**	
CO 1	Explain the data gathering techniques
CO 2	Inspect the data using descriptive statistics
CO 3	Illustrate the probability and conditional probability concepts
CO 4	Distinguish between various probability distributions and analyze the data following different probability distributions
CO 5	Solve the inferential statistics problems using point and interval estimation techniques. Infer the statistical problems using hypothesis testing and p value
Text Books	• Achim Klenke, (2014), Probability Theory A Comprehensive Course Second Edition, Springer, ISBN 978-1-4471-5360-3 • Christian Heumann, Michael Schomaker Shalabh (2016), Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Springer International Publishing, ISBN 978-3-319-46160-1 • Douglas C. Montgomery, (2012), Applied Statistics and Probability for Engineers, 5th Edition, , Wiley India, ISBN: 978-8-126-53719-8

COURSE CODE	R PROGRAMMING FOR DATA SCIENCE	Total Lecture: 45 Practical: 15
AI23B302		(LTP=3-0-2=4)

Course Objectives:

- The basic concepts and syntax of R programming, including data types, data structures, control structures, functions, and packages
- How to manipulate and transform data using R programming, including importing and exporting data, sub setting data, merging data sets, and cleaning data.
- Create visualizations using R programming, including basic and advanced plots, graphs, and charts.
- Learn basic programming concepts such as conditional statements, and loops

UNIT	CONTENTS	HOURS
I.	**Started with R and R Workspace**: Introducing R, R as programming Language, the need of R, Installing R, RStudio, RStudio's user interface, console, editor, environment pane, history pane, filespane, plots pane, package pane, help and viewer pane R Workspace, R's working directory, R Project in R Studio, absolute and relative path, inspecting an Environment, inspect existing Symbols, View the structure of object, removing symbols, Modifying Global Options, Modifying Larming level, Library of Packages, getting to know a package, installing a Package from CRAN, Updating Package from CRAN, Installing package from online repository, Package Function, Masking and name conflicts	10
II.	**Basic Objects and Basic Expressions**: Vectors, Numeric Vectors, Logical Vectors, Character Vectors, subset vectors, Named Vectors, extracting element, converting vector, Arithmetic operators, create Matrix, Naming row and columns, subsetting matrix, matrix operators, creating and subsetting an Array, Creating a List, extracting element from list, subsetting a list, setting value, creating a value of data frame, subsetting a data frame, setting values, factors, useful functions of a data frame, loading and writing data on disk, creating a function, calling a function, dynamic typing, generalizing a function. Assignment Operators, Conditional Expression, using if as expression and statement, using if with vectors, vectorized if: ifelse, using switch, using for loop, nested for loop, while loop	10
III.	**Working with Basic Objects and Strings**: Working with object function, getting data dimensions, reshaping data structures, iterating over one dimension, logical operators, logical functions, dealing with missing values, logical coercion, math function, number rounding functions, trigonometric functions, hyperbolic functions, extreme functions, finding roots, derivatives and integration, Statistical function, sampling from a vector,	9
IV.	Working with random distributions, computing summary statistics, covariance and correlation matrix, printing string, concatenating string, transforming text, Formatting text, formatting date and time, formatting date and time to string, finding string pattern, using group to extract data, reading data	8
V.	**Working with Data – Visualize and Analyze Data**: Reading and Writing Data, importing data using built-in-function, READR package, export a data frame to file, reading and writing Excel worksheets, reading and writing native data files, loading built-in data sets, create scatter plot, bar chart, pie chart, histogram and density plots, box plot, fitting linear model and regression tree	8

List of Experiments:

1. Installation of R and Rstudio
2. Create Matrix in R and perform following operations
   - Create a matrix A and fill with values from 1 to 12
   - Create a matrix B and fill with values from 1 to 12
   - Find the transpose of matrix A and matrix B
   - Find the multiplication of matrix A and matrix B
   - Find the addition of matrix A and matrix B
   - Find the substation of matrix A and matrix B

   Subsetting a Matrix
   - Create a matrix A and fill with values from 4 to 16
   - Get first 2 rows
   - Subset top 2 row and left 2 columns
   - Subset 3 row and 2 column
3. Write a R Program to create a list a_list that contains numbers, strings, logical value, and vectors
   - Add names to the list a_list

- Add an element at the end of the list a_list

4. Create a function calc This function will accept three arguments that include two numeric vectors x and y and one character vector type. The character vector type will define the kind s operation, the user wants to perform.
5. Write a R program to find the numbers between 1000 and 1100 that satisfy (i ^ 2) %% 11 equals (i ^ 3) %% 17, where ^ is a power operator and %% (modulo operator) returns the remainder of a division.
6. Develop a function that can behave differently according to the type of input object.
7. Create scatter plot using more than one dataset use various point styles and colors .
8. Create multi-period line plot, with mix different line types and create Multi Series Chart with Legend.
9. Create bar chart, pie chart and histogram with random data.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Experiment with basic R code, including creating variables, data types, and functions.
CO 2	Examine and manipulate data using R, including importing and exporting data, subsetting data, merging data sets, and cleaning data
CO 3	Build visualizations using R, including basic and advanced plots, graphs, and charts
CO 4	Examine data with the help of statistical analysis using R, including descriptive statistics, regression analysis
CO 5	Apply exploratory data analysis on real time datasets
Text Books	• Hands-On Programming with R by Garrett Grolemund • R for Data Science by Hadley Wickham & Garrett Grolemund

COURSE CODE	MACHINE LEARNING AND PATTERN RECOGNITION	Total Lecture: 45 Practical: 15
AI23B401		(LTP=3-0-2=4)

Course Objectives:

- Help student understand what is machine learning. How business can use machine learning in different domains to gain competitive advantage
- Student is able to differentiate between different learning algorithms.
- Gain a fundamental understanding of the concepts and techniques that underpin machine learning algorithms.

UNIT	CONTENTS	HOURS
I.	**Introduction:** Learning systems, real world applications of machine learning, why machine learning, variable types and terminology, function approximation	10
II.	**Machine Learning:** Supervised learning, unsupervised learning, Reinforcement learning	10
III.	**Important concepts of machine learning:** Parametric vs non-parametric models, the trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no free lunch theorem	9
IV.	**Linear Regression:** Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors	8
V.	**Classification:** Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes' theorem of classification, LDA for p=1, LDA for p>1, quadratic discriminant analysis	8

List of Experiments:

1. Prediction using simple linear regression
2. Prediction using multiple linear regression
3. Classification using Logistics regression
4. Classification using linear discriminant analysis
5. Classification using support vector machine
6. Classification using Guassian Naïve Bayes
7. Classification using decision Tree
8. Classification using Random Forest
9. Classification using K nearest neighbour

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Explain the use of Machine Learning Models in business and understand machine learning models can be used to solve business problems.
CO 2	Compare machine learning algorithms such as supervised, unsupervised, and reinforcement learning models
CO 3	Identify the performance of different machine learning models and compare them to optimize the results
CO 4	Make use continuous and discrete data set to fit regression and classification models
CO 5	Simulate and understand how machine will have power to accomplish the task
Text Books	• Machine Learning by Tom M. Mitchell - McGraw Hill Education; First edition • Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop - Springer; 1st ed. 2006. Corr. 2nd printing 2011 edition • The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman - Springer; 2nd ed. 2009, Corr. 9th printing 2017 edition

COURSE CODE	DATA VISUALIZATION AND STORY TELLING	Total Lecture: 45 Practical: 15
AI23B402		(LTP=3-0-2=4)

Course Objectives:

- Understand manage and manipulate data in order to extract useful information and insights
- Help to understand manipulate data is by using functions that are pre-built sets of code that perform specific tasks or operations on data.
- It will be able to analyse data on consumer preferences, purchasing habits, and other behaviours in order to develop insights that can be used to improve marketing and sales strategies.

UNIT	CONTENTS	HOURS
I.	**INTRODUCTION TO DATA HANDLING** Overview of Data analysis, Introduction to Data visualization, Working with statistical formulas - Logical and financial functions	10
II.	Power BI Analytics, Data Validation & data models, Power Map for visualize data, Power BI-Business Intelligence, Data Analysis using statistical methods, Dashboard designing	10
III.	**INTRODUCTION TO DATA MANIPULATION USING FUNCTION**: Heat Map, Tree Map, Smart Chart, Azure Machine learning, Column Chart, Line Chart, Pie, Bar, Area, Scatter Chart	9
IV.	Data Series, Axes, Chart Sheet, Trendline, Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart	8
V.	Gantt Chart, Pareto Chart etc., Frequency Distribution, Pivot Chart, Slicers, Tables: Structured References, Table Styles, What-If Analysis: Data Tables| Correlation model |Regression model	8

List of Experiments:

1. Importing Data: Practice importing data from different sources such as Excel, CSV, or databases.
2. Data Transformation: Learn to clean and transform data using Power Query Editor.
3. Data Modeling: Build relationships between tables and create calculated columns and measures.
4. Visualization Basics: Create simple charts like bar graphs, line charts, and pie charts.
5. Interactive Filters: Add slicers and filters to enable interactivity in your visualizations
6. Implement the following Substitution & Transposition Techniques concepts: a) Caesar Cipher b) Rail fence row & Column Transformation

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Build data models and manage and manipulate data to extract useful information and insights
CO 2	Apply functions to manipulate and analyze data
CO 3	Discover customer preference, purchasing habits, and other behaviors
CO 4	Analyze internal and external factors by understanding "Mind and Market Factors" component of MIMI
CO 5	Make use of Tableau software for data visualization
Text Books	• "Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few • "Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsk

COURSE CODE	ADVANCE MACHINE LEARNING	Total Lecture: 45 Practical: 15
AI23B501		(LTP=3-0-2=4)

Course Objectives:

- Gain a fundamental understanding of the concepts and techniques that underpin machine learning algorithms
- Learn how to choose the appropriate regression and classification algorithms, how to prepare data for machine learning models, and how to evaluate model performance

UNIT	CONTENTS	HOURS
I.	**Resampling Methods, Model Selection and Regularization:** Cross- validation, leave-one-out cross-validation, k-fold cross-validation, the bootstrap, subset selection, shrinkage methods, ridge and lasso regression, dimension reduction methods, principal components regression, partial least square	10
II.	**Tree Based Methods:** Advantages and disadvantages of trees, regression Trees, classification trees, bagging, random forest, boosting	10
III.	**Support Vector Machine**: Maximum margin classifier, classification using a separating hyperplane, the maximal margin classifier, support vector classifier, support vector machines, classification with non-linear decision boundaries, support vector machine, one-versus-one classification, one-versus-many classification	9
IV.	**Unsupervised Learning:** Principle component analysis, what are principal components, clustering methods, k-means clustering, hierarchical clustering, Independent component analysis, latent semantic indexing, Markov Models, Hidden Markov Models	8
V.	**Scalable Machine Learning** (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	8

List of Experiments:

1. Lasso and Ridge regression implementation
2. Principal component analysis implementation
3. Making predictions using multiple Logistics regression
4. Implementation of correlation matrix, correlation matrix , ROC curve
5. Faudulent transaction using classification algorithm
6. Predict whether a patient have diabetes
7. Improve sales of product of a company
8. Finance - Predict whether a credit card user will default on monthly credit card payment based on annual income and monthly credit card balance
9. HR - Predict the Baseball major league player salary based on career and previous season statistics

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Explain the use of Machine Learning Models in business and understand machine learning models can be used to solve business problems.
CO 2	Compare machine learning algorithms such as supervised, unsupervised, and reinforcement learning models
CO 3	Identify the performance of different machine learning models and compare them to optimize the results
CO 4	Make use continuous and discrete data set to fit regression and classification models
CO 5	To mathematically analyse various machine learning approaches and paradigms
Text Books	• Machine Learning by Tom M. Mitchell - McGraw Hill Education; First edition • Pattern Recognition and Machine Learning (Information Science and Statistics) by Christopher M. Bishop - Springer; 1st ed. 2006. Corr. 2nd printing 2011 edition • The Elements of Statistical Learning: Data Mining, Inference, and Prediction by Trevor Hastie, Robert Tibshirani, Jerome Friedman - Springer; 2nd ed. 2009, Corr. 9th printing 2017 edition

COURSE CODE	SCALA FOR DATA SCIENCE	Total Lecture: 45 Practical: 15
AI23B502		(LTP=3-0-2=4)

Course Objectives:

- Learn the foundations of the language for developers and data scientists interested in using Scala for data analysis. Tackle data analysis problems involving Big Data, Scala and Spark.
- Get a solid understanding of the fundamentals of the language, the tooling, and the development process.
- Develop a good appreciation of more advanced features.

UNIT	CONTENTS	HOURS
I.	**Scala Language:** Getting to know Scala programming language, Scala and Java, statically typed language, Apache Spark and Scala, Scala Performance Benefits, Installing Scala, Using Scala REPL/Shell, getting help from Scala shell, Hello World, paste mode, retrieving history, auto-complete feature, exiting from Scala REPL	10
II.	**Variables, Data Types, Conditional Statements:** Immutability of variables, define mutable and immutable variables, mutability and type safety, Specifying types for variables, Scala Identifier rules, naming conventions, Scala data types, Boolean types, string type, multiline strings, string operations, string concatenation, string interpolation, length of string, splitting string, extracting part of string, index of character of strings, the ANY type, type casting, Boolean expressions, conditional statement in Scala, nested IF/ELSE statement, pattern matching	10
III.	**Code Blocks, Functions, Collections:** Code Blocks in Scala, Why use functions in Scala, understanding functions in Scala, define and invoke a function, functions with multiple parameters, positional parameters, functions with no argument, single-line function, passing function as argument, anonymous function, Collections in Scala, Understanding List, list size, convert list to string, iterating over list, map function and collection, foreach, reduce operation, list equality, create set, indexing map, manipulating maps, understanding tuples, indexing tuples, mutable collections, nested collections	9
IV.	**Loops, Packages, Classes:** For loop, while loop, Breaking Loop iteration, classes and objects in Scala, create classes and objects, singleton objects, case classes, equality checks, classes and packages, avoid name space collusion	8
V.	**Exceptional Handling:** importing package, fundamental of exception handling, type inferences and exception handling, try, catch, finally, Scala built tool (SBT), Compile Scala applications	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Learn to leverage the integration of Apache Spark™ and Scala.
CO 2	Learn how use Spark's machine learning pipelines to fit models and search for optimal hyperparameters using Scala in a Spark cluster.
CO 3	Understand how parallel collections enable trivial parallelisation of statistical computing algorithms
CO 4	Understand the advantages of using Apache Spark as a Big Data analytics platform
CO 5	Apply the tool to solve real life problems
Text Books	• Programming in Scala: A comprehensive Step-by-Step Scala Programming Guide by Martin Odersky, Lex Spoon, Bill Venners • Scala for the Impatient by Cay Hortsmann • Scala in Depth by Joshua D Suereth

COURSE CODE	DEEP LEARNING AND NEURAL NETWORK	Total Lecture: 45 Practical: 15
AI23B601		(LTP=3-0-2=4)

Course Objectives:

- The objective of this course is to teach students the basic concepts of neural networks, neurons, and deep learning.
- The student gets an opportunity to learn the programming languages (TensorFlow) to design the deep learning models
- The student learns the concepts behind CNN, RNN

UNIT	CONTENTS	HOURS
I.	**The neural network:** The neuron, linear perceptron, feed-forward neural network, limitations of linear neurons, sigmoid, tanh, relu neurons, softmax output layer, information theory, cross entropy, Kullback-Leibler divergence	10
II.	**Training feed-forward neural network:** Gradient Descent, delta rules and learning rates, gradient descent with sigmoidal neurons, the backpropagation algorithms, stochastic and minibatch gradient descent, test sets, validation sets and overfitting, preventing overfitting	10
III.	**Tensor Flow:** Computation graphs, graphs, sessions and fetches, constructing and managing graph, flowing tensors, sessions, data types, tensor arrays and shapes, names, variables, placeholders and simple optimization, linear regression and logistic regression using tensorflow	9
IV.	**Implement Neural Network:** Introduction to Keras, Build neural network using Keras, Evaluating models, data preprocessing, feature engineering, feature learning, overfitting, underfitting, weight regularization, dropout, universal workflow of deep learning.	8
V.	**Optimization for Train Deep Models:** Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second- Order Methods, Optimization Strategies and Meta-Algorithms Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing	8

List of Experiments:

1. Tensorflow installation, comparison of tensorflow and python
2. Code comparison between tensorflow 1.x and 2.x
3. Construct and managing the computation graph using tensorflow
4. Create constant, variables and placeholders using tensorflow
5. Build tensorflow estimator and data pipeline
6. Build a regression model on a real dataset (the Boston housing price dataset)

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Discuss feed forward networks and their training issues
CO 2	Distinguish different types of ANN architectures
CO 3	Design Feed Forward Neural Network architecture for research problems
CO 4	Apply mathematical concepts such as linear algebra, calculus to solve the research problems.
CO 5	Apply deep learning techniques to practical problems
Text Books	• Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach - MIT Press (3 January 2017) • Tensor Flow for Deep Learning by Reza Zadeh, Bharath Ramsundar - Shroff/O'Reilly; First edition (2018)

COURSE CODE	ADVANCE DATA VISUALIZATION	Total Lecture: 45 Practical: 15
AI23B602		(LTP=3-0-2=4)

Course Objectives:

- It will be able to analyze data on consumer preferences, purchasing habits, and other behaviors in order to develop insights that can be used to improve marketing and sales strategies.
- It helps to understand "Mind and Market Factors" component of MIMI involves analyzing both the internal and external factors that influence consumer behavior and market trend
- To use Tableau Software for data visualization. This software provides the most efficient way to change or transform the raw data into an easily understandable format

UNIT	CONTENTS	HOURS
I.	**Data Strategy & Consumer behaviour Analytics:** Understanding Product & Category, Competitive Analysis, Market Share understanding- Market potential Index, Seasonality-Sales Trending, Consumer behaviour Analytics-MIND AND MARKET FACTORS	10
II.	Budget planning & Execution- MIMI, Regression & Correlation Analysis for Sales trending, Forecasting method with predictive investment modelling, Cohort Analysis, Google Analytics (GA)	10
III.	**TABLEAU SOFTWARE: GETTING STARTED WITH TABLEAU SOFTWARE:** What is Tableau? What does the Tableau product suite comprise of? How Does Tableau Work? Tableau Architecture, what is my Tableau Repository? Connecting to Data & Introduction to data source concepts,	9
IV.	Understanding the Tableau workspace, Dimensions and Measures, Data Types & Default Properties, building basic views, saving and sharing your work-overview.	8
V.	Introduction to Qlikview and other tools, Case Studies-Assignments	8

List of Experiments:

1. Conditional Formatting: Apply formatting rules based on data values to highlight important information.
2. Drill-through Pages: Build drill-through pages to allow users to navigate through different levels of data.
3. Hierarchies: Explore how to create hierarchies for easier data exploration.
4. Custom Visuals: Experiment with adding custom visuals from the Power BI marketplace.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Build data models and manage and manipulate data to extract useful information and insights
CO 2	Apply functions to manipulate and analyze data
CO 3	Discover customer preference, purchasing habits, and other behaviors
CO 4	Analyze internal and external factors by understanding "Mind and Market Factors" component of MIMI
CO 5	Make use of Tableau software for data visualization
Text Books	• "Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few • "Beautiful Visualization, Looking at Data Through the Eyes of Experts by Julie Steele, Noah Iliinsk

COURSE CODE	ADVANCE DEEP LEARNING	Total Lecture: 45 Practical: 15
AI23B701		(LTP=3-0-2=4)

Course Objectives:

- The student learns the concepts behind CNN, RNN, LSTM, Autoencoders, and GANs.
- The hands on learning will help build strong knowledge base for designing advanced deep learning models

UNIT	CONTENTS	HOURS
I.	**Moving beyond gradient descent:** Local minima vs global minima vs saddle, model identifiability, correcting gradient points in wrong directions, Momentum based optimization, second order methods, learning rate adaption, adagrad, rmsprop, adam	10
II.	**Convolutional Neural Network**: Convolution operation, filters and feature maps, motivation, sparse interactions, parameter sharing and equivariant representation, padding and stride, max pooling, full architectural description of convolutional network, build cnn using data augmentation, using pretrained convnet, visualize what convnet learn	10
III.	**Embedding and Representation Learning:** Principle component analysis, working with text data, one-hot encoding of words and characters, word embedding, autoencoder architecture, denoising, sparsity, Word2vec framework, Skip-Gram architecture	9
IV.	**Models for Sequence Analysis:** Analysing Variable-length inputs, Seq2seq with neural n-gram, part of speech tagger, dependency parse, syntaxnet, recurrent neural network, challenges with vanishing gradients, long short term memory units	8
V.		8

List of Experiments:

1. Build tensorflow estimator and data pipeline
2. Build a regression model on a real dataset (the Boston housing price dataset)
3. Build a classification model on a real dataset (Titanic dataset)
4. Build deep neural networks for single and multiple inputs.
5. Installation of keras and simple keras program
6. MNIST using keras- build data pipeline, plot training and validation accuracy

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Neural Network, Feed Forward and Backpropogation
CO 2	Tensorflow and Keras
CO 3	RNN, CNN, Autoencoders
CO 4	
CO 5	
Text Books	• Deep Learning with Python by Francois Chollet - Manning Publications; 1 edition • Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach - MIT Press (3 January 2017)

COURSE CODE	NATURAL LANGUAGE PROCESSING USING CHAT GPT	Total Lecture: 45 Practical: 15
AI23B702		(LTP=3-0-2=4)

Course Objectives:

- The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable
- It helps resolve ambiguity in language and adds useful numeric structure to the data for many downstream applications, such as speech recognition or text analytics.

UNIT	CONTENTS	HOURS
I.	**Introduction to NLP:** Natural Language Processing in real world, What is language, Approached to NLP, **Build NLP model:** Eights Steps for building NLP Model, Web Scrapping	10
II.	**Text Representation:** Basic Vectorization, One-Hot Encoding, Bag of Words, Bag of N Grams, TF-IDF, Pre-trained Word Embedding, Custom Word Embeddings, Vector Representations via averaging, Doc2Vec Model, Visualizing Embeddings using TSNW and Tensorbaord **Text Classification:** Application of Text Classification, Steps for building text classification system, Text classification using Naïve Bayes Classifier, Logistic Regression, and Support Vector Machine, Neural embedding for Text Classification, text classification using deep learning, interpret text classification model	10
III.	**Information Extraction:** Applications of Information Extraction, Processes for Information Extraction. Key phrase Extraction, Named Entity Recognition, Disambiguation and linking of named entity, Relationship extraction **Chatbot:** Real life applications of chatbot, Chatbot Taxonomy, Dialog Systems, Process of building a dialog, Components of Dialog System, End to End Approach, Rasa NLU	9
IV.	**NLP for social media:** Application of NLP in social media, challenges with social media, Natural Language Processing for Social Data, Understanding Twitter Sentiments, Identifying memes and Fake News	8
V.	**NLP for E-Commerce**: E-commerce catalog, Search in E-Commerce, How to build an e-commerce catalog, Review and Sentiment Analysis, Recommendations for E-Commerce.	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Solve ambiguity in language and adds useful numeric structure to the data for many downstream applications, such as speech recognition or text analytics.
CO 2	Build systems that can make sense of text and automatically perform tasks like translation, spell check, or topic classification
CO 3	
CO 4	
CO 5	
Text Books	• Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper. • Foundations of Statistical Natural Language Processing by Christopher Manning and Hinrich Schütze

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

Discipline Specific Electives (DSE)
Cyber Security and Forensic

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	FOUNDATION TO ARTIFICIAL INTELLIGENCE, DATA SCIENCE AND CYBER SECURITY	Total Lecture: 45 Practical: 15
CY23B101		(LTP=3-0-2=4)

Course Objectives:

- To learn about the Artificial Intelligence, Cyber security and its evolution
- To differentiate between different learning algorithms and analytics frameworks
- To understand different data science processes, tools and techniques
- To know the processes that are required to execute a data science project successfully
- To extract information from different data sets using Excel

UNIT	CONTENTS	HOURS
I.	**Introduction to Data Science:** Defining Data Science and Big Data, Benefits and Uses of Data Science and Big Data, Facets of Data, Structured Data, Unstructured Data, Natural Language, Machine generated data, Graph based or Network Data, Audio, Image, Video, Streaming data, Data Science Process, Big data ecosystem and data science, distributed file systems, distributed programming framework, data integration framework, machine learning framework, No SQL Databases, scheduling tools, benchmarking tools, system deployments	10
II.	**Data Science Processes:** Six steps of data science processes, define research goals, data retrieval, cleansing data, correct errors as early as possible, integrating – combine data from different sources, transforming data, exploratory data analysis, Data modelling, model and variable selection, model execution, model diagnostic and model comparison, presentation and automation	10
III.	**Introduction to Cybersecurity:** What is Cybersecurity, Cybersecurity and Privacy, Black Hats vs White Hats, Type of Black Hats, Script Kiddies, Organized Criminals, Hactivists, State Actors, APT, Type of White Hats, Cybersecurity Consultants, Cybersecurity Architects, CISO, Incident Responders, Vulnerability Managers and Threat Hunters, Computer Foreign Analysts, Penetration Testers, Cybersecurity Communities	9
IV.	**Introduction to AI:** What is AI, Turing test, cognitive modelling approach, law of thoughts, the relational agent approach, the underlying assumptions about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, history of AI	8
V.	**Introduction to Data Analytics:** Working with Formula and Functions, Introduction to Power BI & Charts, Logical functions using Excel, Analysing Data with Excel.	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Outline the key concepts of AI and how AI has evolved
CO 2	Identify the key concepts of Machine Learning and will be able to differentiate between key algorithms such as supervised learning and unsupervised learning
CO 3	Distinguish key Data Science concepts such as structured and unstructured data, SQL and NoSQL Database
CO 4	Examine the process required the successfully execute a Machine Learning or Data Science project
CO 5	Infer the large scale data using Excel
Text Books	• Artificial Intelligence 3e: A Modern Approach Paperback – By Stuart J Russell & Peter Norvig; Publisher – Pearson • Artificial Intelligence Third Edition By Kevin Knight, Elaine Rich, B. Nair – McGrawHill • Artificial Intelligence Third Edition By Patrick Henry Winston – Addison-Wesley Publishing Company

COURSE CODE	PYTHON FOR CYBER SECURITY	Total Lecture: 45 Practical: 15
CY23B201		(LTP=3-0-2=4)

Course Objectives:

- Understand the basic concepts of Python Programming
- Learn and practice the python programming data structure, functions, and file handling
- Use the multidimensional array objects in Numpy to statistical analyze the data
- Load the data into a pandas data frame and complete the data wrangling exercise
- Plot the graphs using matplotlib and seaborn

UNIT	CONTENTS	HOURS
I.	**Python programming Basic**: Python interpreter, IPython Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow	10
II.	**Data Structure, functions, files:** tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems	10
III.	**NumPy: Array and vectorized computation:** Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array	9
IV.	**Pandas:** Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format	8
V.	**Visualization with Matplotlib:** Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration **Plotting with pandas and seaborn:** line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate the understanding of basic concepts of Python Programming and IPython
CO 2	Apply the key python data structure such as list, dict, set, and tuple along with functions to clean data
CO 3	Utilize the Numpy multidimensional arrays to slice, and index the data
CO 4	Analyze the data using pandas data frame by loading data from system and build competency in data wrangling
CO 5	Examine the data by plotting graphs using matplotlib and seaborn
Text Books	• Achim Klenke, (2014), Probability Theory A Comprehensive Course Second Edition, Springer, ISBN 978-1-4471-5360-3 • Christian Heumann, Michael Schomaker Shalabh (2016), Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Springer International Publishing, ISBN 978-3-319-46160-1
Reference Books	• Douglas C. Montgomery, (2012), Applied Statistics and Probability for Engineers, 5th Edition, , Wiley India, ISBN: 978-8-126-53719-8.

COURSE CODE	INTRODUCTION TO COMPUTATIONAL THINKING	Total Lecture: 45 Practical: 15
CS20B108		(LTP=3-0-2=4)

Course Objectives:

The aim of this course is hence to take students with no prior experience of thinking in a computational manner to a point where they can derive simple algorithms and code the programs to solve some basic problems in their domain of studies. In addition, the course will include topics to appreciate the internal operations of a processor, and raise awareness of the socio-ethical issues arising from the pervasiveness of computing technology.

UNIT	CONTENTS	HOURS
I.	Computer Networking: Introduction, Goals, ISO-OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Introduction to Internet, World Wide Web, E-commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking,, Logic bombs, Hacking Spamming, Cyber Defamation, pharming Security measures Firewall, Computer Ethics & Good Practices, Introduction of Cyber Laws about Internet Fraud, Good Computer Security Habits,	10
II.	CT concept – Abstraction, Decomposition, Pattern recognition, Algorithm, Limit of computing, Analysis of Algorithm Complexity, Space and time Complexity, code optimization.	10
III.	Human intelligence and artificial intelligence, introduction, Need of AI and its application. Introduction to Internet of thing, characteristics, benefits, hardware and its application. Introduction of Data science and its application. Cloud computing: definition, characteristics, service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public, private, community and hybrid clouds), Pros and Cons of cloud computing. Edge and Fog Computing, Quantum Computers. Introduction of Big Data and Hadoop.	9
IV.	Data base Management System: Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages	8
V.	Computer: Definition, Classification, Organization i. e. CPU, register, Bus architecture, Instruction set, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer Application in E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and Climatology, Computer Gaming, Multimedia and Animation etc. Operating System: Definition, Function, Types, Management of File, Process & Memory. Introduction to MS word, MS PowerPoint, MS Excel	8

List of Experiments:

11. Study and practice of Internal & External DOS commands.
12. Study and Practice of MS windows –Folder related operations, My-Computer, window explorer, Control Panel,
13. Creation and editing of Text files using MS-word.
14. Creation and operating of spreadsheet using MS-Excel.
15. Creation and editing power-point slides using MS-power point.
16. Study of the features of firewall in providing network security and to set Firewall Security in windows.
17. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
18. Connect the computers in Local Area Network.
19. Case Study of Google App Engine.
20. Case Study of Different internetworking devices.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Explain**[4] the internal operation of a basic processor, how a program is executed by a computer and computing trends.
CO 2	**Express**[2] basic programs based on the programming language used in the course.

CO 3	Formulate a problem and **express**[2] its solution in such a way that a computer can effectively carry it out. (i. e. equip you with CT skills)
CO 4	**Apply**[3] the CT concepts on case studies/problem-based scenarios through hands-on practice of the CT process.
CO 5	**Associate**[2] knowledge of Microsoft office suit and have hands on it.
Text Books	• Forouzan Behrouz A. (2007): **Data communication & networking,** fourth edition**,** Noida: MC Graw-Hill • Korth Henry F (1997): **Data base system concept,** 6th edition**,** Noida: McGraw-Hill Education. .
Reference Books	• Malhotra T D (2020): **New trends in computer,** 1st edition**,** Delhi: Evergreen Publications.

COURSE CODE	FOUNDATION TO CYBER SECURITY AND DIGITAL FORENSIC	Total Lecture: 45 Practical: 15
CY23B301		(LTP=3-0-2=4)

Course Objectives:

- The objective of this course is to teach students the concepts of Cyber Security Objectives are used to organize specific topics or individual learning activities to achieve the overall learning outcome.

UNIT	CONTENTS	HOURS
I.	**Introduction to Cybersecurity:** What is Cybersecurity, Cybersecurity and Privacy, Black Hats vs White Hats, Type of Black Hats, Script Kiddies, Organized Criminals, Hactivists, State Actors, APT, Type of White Hats, Cybersecurity Consultants, Cybersecurity Architects, CISO, Incident Responders, Vulnerability Managers and Threat Hunters, Computer Foreign Analysts, Penetration Testers, Cybersecurity Communities	10
II.	**Internet Attacks:** How internet works, TCP/IP Backbone of Internet, Public vs Private network, Black Hat attack methodology, Reconnaissance, Weaponization, Delivery, Exploitation and Installation, Command and Control, and Attack on Objectives, How Black Hat works, Protection from Black Hats, The Internet Is Open, The Internet Is Public, How to Analyse Network	10
III.	**Phishing Tectices:** What is Phishing, all phishings are not obvious, Vishing and other non-email Phishing, how to protect Phishing, Typosquatting, Complex URLs and Redirects, Modifying DNS Records, Hoaxes, Why Black Hats Love Ohising, Analyze Phishing Email	9
IV.	**Malware Infections:** What is malware, types of malwares, Viruses, Worms, Trojans, Ransomware, Spyware and Adware, Rootkits and Bootkits, Polymorphic Malware, How Black Hats Deploy Malware, How to Defend Against Malware, Analyzing Malware and Managing Antivirus Settings.	8
V.		8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Security and networking foundations.
CO 2	Logging and monitoring procedures.
CO 3	Web application security techniques.
CO 4	
CO 5	
Text Books	• Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing Author: John Slavio • Cybersecurity for Beginners by Raef Meeuwisse

COURSE CODE	ANALOG AND DIGITAL COMMUNICATION	Total Lecture: 45 Practical: 15
CS20B209		(LTP=3-0-2=4)

Course Objectives:
Students will learn Analog and digital communication including techniques of analog and digital modulation and demodulation as well as the transmitter and receiver designs for the communication systems.

UNIT	CONTENTS	HOURS
I.	Introduction to communication systems: Elements of Communication System, Need for modulation, Technologies in Communication Systems, Signal representation and analysis Noise: External noise, Internal noise, Noise calculations, Noise figure, Noise temperature.	10
II.	Amplitude modulation techniques: Elements of Analog Communication, Amplitude modulation techniques, Generation of AM signals. Angle modulation techniques: Theory of Angle Modulation techniques, Practical Issues in FM, Generation of FM.	10
III.	Radio Transmitters and Receivers: Introduction to Radio Communication, Radio Transmitters, Receiver types, AM receivers, FM receivers, SSB Receivers. Pulse Modulation techniques: Pulse Analog modulation techniques, Pulse Digital Modulation techniques.	9
IV.	Digital Modulation Techniques: Introduction, basic digital modulation techniques: ASK, FSK, PSK. Digital Demodulation techniques: basic digital modulation techniques: ASK, FSK, PSK	8
V.	Spread Spectrum Communications: Introduction to Frequency hopping, Introduction to direct sequence Spread Spectrum, Introduction to CDMA, and Overview of latest trends in digital communication.	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Understand**[2] how the analog and digital modulation occurs.
CO 2	**Understand**[2] working of electronic communication system.
CO 3	**Learn**[1] the modulation technique
CO 4	**Identify**[2] the communication spectrum
CO 5	**Use**[3] digital modulation techniques.
Text Books	• Electronic Communications, Dennis Roddy, John Coolen. • Electronic Communication Systems, George Kennedy, Bernard Davis, S R M Prasanna
Reference Books	• Modern Digital and Analog Communication Systems, by B. P. Lathi and Zhi Ding

COURSE CODE	CRYPTOGRAPHY WITH PYTHON	Total Lecture: 45 Practical: 15
CY23B401		(LTP=3-0-2=4)

Course Objectives:

- The objective of this course is to teach students the concepts of Cryptography with Python.
- This tutorial covers the basic concepts of cryptography and its implementation in Python scripting language
- After completing this course, you will be able to relate the basic techniques of cryptography in real world scenarios

UNIT	CONTENTS	HOURS
I.	**Introduction to Cryptography:** Setting Up Python Environment, Shift Cipher, Shift Cipher encoder, Shift Cipher decoder, Introduction to Cryptography, Uses of Cryptography, What Could Go Wrong?, The cryptodoneright.org Project	10
II.	**Hashing:** Hash Liberally with hashlib, MD5, Preimage Resistance, Non-negative Integers, Second-Preimage and Collision Resistance, Digestible Hash, Hash Passwords, Cracking Weak Passwords, Proof of Work	10
III.	**Symmetric Encryption:** Symmetric ciphers, What is Encryption, Confidentiality, Integrity, Authentication, AES: A Symmetric Block Cipher, ECB, Spontaneous Independence, Cipher block chaining (CBC) mode, Proper Padding, Hygienic IVs, Key Streams, Key and IV Management, Exploiting Malleability, Weak Keys, Bad Management, Other Encryption Algorithms, finalize()	9
IV.	**Asymmetric Encryption:** Public/Private Keys, Getting Keyed Up, RSA Done Wrong, Stuffing the Outbox, How Asymmetric Encryption is Different?, Pass the Padding, Deterministic Outputs, Chosen Ciphertext Attack, Common Modulus Attack, The Proof Is in the Padding, Exploiting RSA Encryption with PKCS #1 v1.5 Padding, Step 1: Blinding, Step 2: Searching for PKCS-Conforming Messages, Step 3: Narrowing the Set of Solutions, Step 4: Computing the Solution, Additional Notes About RSA, Key Management, Algorithm Parameters, Quantum Cryptography	8
V.		8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Apply the fundamental concepts of cryptography
CO 2	Describe the difference between symmetric and asymmetric cryptography
CO 3	Define the basic requirements for cryptography
CO 4	Identify processes to support secure protocols & etc.
CO 5	
Text Books	• Practical Cryptography in Python: Learning Correct Cryptography by Example by Dr. Seth James Nielson and Christopher K • Cryptography: A Very Short Introduction : Fred Piper, Sean Murphy

COURSE CODE	DATA COMMUNICATION	Total Lecture: 45 Practical: 15
CS20B402		(LTP=3-0-2=4)

Course Objectives:

- Students are expected to learn basics of Communication Technologies and data communication which will help them to build fundamentals for learning Computer Networksin higher semester.
- The course is designed to let students demonstrate an understanding of the fundamentals ofdata communication,
- Understand types of transmission mediums and interfacing standards along with current edgeof the data compression techniques.
- Students are introduced to data communication network design and its operations
- Student should understand Transmission media & switching elements.

UNIT	CONTENTS	HOURS
I.	**Signal Characteristic:** Analog and Digital, Periodic Analog Signals, Digital Signals, TransmissionImpairments, Data rate limits, Performance **Data Communication:** Basics of data communication, Networks, Internet and protocol standards, OSI, TCP-IP models.	10
II.	**Signal Encoding Techniques:** Digital to digital Conversion, Data transmission modes, Analog to analog transmission, Digital to analog transmission, Bandwidth Utilization: Multiplexing and Spreading. Frequency division multiplexing (FDM), Time division multiplexing (TDM), T1 multiplexing hierarchy, E1 multiplexing hierarchy, Statistical TDM, Spread Spectrum, SONET/SDH	10
III.	**Transmission Media:** Guided media, optical fiber, wireless media, Switching System and Communication Networks: Circuit Switching, Datagram and virtual network, structure of switch networks, Telephone network, Modem andDSL, cable TV networks	9
IV.	**Wireless WAN:** Cellular telephone, Satellite communication. **Communication Technologies:** Ethernet, Bluetooth, Wifi, RF, Infrared, Zigbee, NFC	8
V.	**Data Link Control:** Framing, Flow and error control, protocols, noiseless channels, noisy channel, HDLC, Point to Point Protocol	8

List of Experiments:

1. Perform pulse coded modulation for analog to digital conversion. Analyze bandwidth requirement, data rate generation, synchronous and asynchronous mode of transmission.
2. Perform bandwidth utilization technique time division multiplexing.
3. Perform various line coding formats and compare transmission characteristic of each formats.
4. Perform digital carrier modulation techniques used in wireless communication.
5. Perform amplitude modulation and demodulation.
6. Perform serial data communication between two data terminal equipment using optical link.
7. Perform digital data transfer through RF transmitter and receiver.
8. Demonstration of different types of cables used in data communication.
9. Demonstration of different types of cables used in data communication.
10. Perform Installation of LAN and troubleshooting of frequently occurred problems.
11. Create and test wireless sensor networks using zigbee.
12. To study various aspects of data communication by field visit at data centre.
13. Perform data communication using IR.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to:

CO 1	**Understand**[2] importance of data communication systems and fundamentals. UnderstandPhysical layer of LAN, MAN and WAN
CO 2	**Distinguish**[4] and relate various physical Medias, interfacing standards and adapters

CO 3	**Explain**[2]various flow control techniques
CO 4	**Analyze**[4] various modulation technique in analog and digital system
CO 5	**Analyze**[4]short range and long-range wireless technologies
Text Books	• Andrew S. Tanenbaum**: Computer Networks, Fifth** Edition**,** New Dehli: Pearson Education. • Behrouz A. Forouzan**: Data Communication and Networking, Fourth** Edition**,** New Dehli: Tata McGraw Hill. • Gupta Prakash C.: **Data Communication**, **New** Delhi: Prentice Hall India Publication
Reference Books	• Godbole A.: **Data Communication & Network**, **Noida**: Tata Mcgraw Hills Education. • Miller**: Data Network and Communication**: Cengage Delmar Learning • Stallings William**: Data & Computer Communication**, **New** Dehli: Pearson Education. .

COURSE CODE	WINDOWS DIGITAL INVESTIGATION WITH POWERSHELL AND PYTHON	Total Lecture: 45 Practical: 15
CY23B501		(LTP=3-0-2=4)

Course Objectives:

- Understand PowerShell
- Basics of PowerShell for investigation
- PowerShell Pipelining
- PowerShell Scripting
- Python for Investigation

UNIT	CONTENTS	HOURS
I.	Powershell for investigation: Experiment with PowerShell, Navigating PowerShell ISE, Introduction to Some Key CmdLets, Get-Help, Get-Process	10
II.	PowerShell Pipelining: CmdLet Pipelining? Get-Service, Get-Process, PowerShell Automatic Variables, Adding the NetTCP Connections CmdLet, How to Discover CmdLets?, Using PowerShell Variables with CmdLets, ForEach-Object, Creating a Single Pipeline Solution, Resolving Remote IP Addresses	10
III.	PowerShell Scripting: Basic Facts About PowerShell Scripts, The Event Processor PowerShell Script, Event Log CmdLets, Creating the Script, Script Header, .Synopsis Section, .Description Section, .Parameters Section, .Examples Section, Parameter Definition, Local Variable Definition, CmdLet Pipeline Execution, Event Processor Script Execution, Resulting Directory, HTML Output Report.	9
IV.	Python for Investigation: What Is “By Example”?, Directing PowerShell with Python, Launching PowerShell CmdLets from Python, Creating a System Files Baseline with PowerShell and Python, Overview of the New Code Sections in VerifyBaseline.py, Python Execution with PowerShell	8
V.		8

List of Experiments:

Course Outcome as per Bloom’s Taxonomy

At the end of the course the students will be able to**:**

CO 1	Learn the concepts of PowerShell
CO 2	PowerShell Pipelining
CO 3	PowerShell Scripting
CO 4	Python for Investigation
CO 5	
Text Books	• PowerShell and Python Together: Targeting Digital Investigations by Chet Hosmer

COURSE CODE	INTERNET OF THINGS	Total Lecture: 45 Practical: 15
CS20B505		(LTP=3-0-2=4)

Course Objectives:

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT Protocols (Data link, Network, Transport, Session, Service)
- To understand Transport layer & Session layer Protocols.
- To understand Service layer & Application Layer Procotols.

UNIT	CONTENTS	HOURS
I.	Evolution of Internet of Things - Enabling Technologies - IoT Architectures: oneM2M - IoT World Forum (IoTWF) and Alternative IoT models - Simplified IoT Architecture and Core IoT Functional Stack - Fog - Edge and Cloud in IoT - Functional blocks of an IoT ecosystem - Sensors - Actuators - Smart Objects and Connecting Smart Objects.	10
II.	IoT protocols and software: MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP, XMPP and gateway protocols, IoT Communication Pattern, IoT protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA,Lifi,Widi)	10
III.	Design Methodology - Embedded computing logic - Microcontroller - System on Chips - IoT system building blocks - Arduino Board details - IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.	9
IV.	IoT security: Need for encryption, standard encryption protocol, light weight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security. open source IoT platforms, cloud dashboards.	8
V.	IoT application and its Variants: Case studies: IoT for smart cities, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0,IoT standards.	8

List of Experiments:

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Understand** the definition and significance of the Internet of Things
CO 2	**Discuss** the architecture, operation, and business benefits of an IoT solution
CO 3	**Understand** various layers and Examine the potential business opportunities that IoT can uncover

CO 4	**Understand** the relationship between IoT, cloud computing, and big data
CO 5	**Identify** how IoT differs from traditional data collection systems
Text Books	• Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, 2014, "From Machine-to-Machine to the Internet of Things:Introduction to a New Age of Intelligence", 1st Edition, Academic Press. • Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer • Vijay Madisetti and ArshdeepBahga, 2014 "Internet of Things (A Hands-on Approach)", 1 st Edition, VPT.
Reference Books	• Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications • Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI. • http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

COURSE CODE	ETHICAL HACKING AND PENETRATION TESTING	Total Lecture: 45 Practical: 15
CY23B601		(LTP=3-0-2=4)

Course Objectives:

- The objective of this course is to teach students the concepts of Ethical Hacking
- This course will also teach how a cybercriminal can take advantage of security vulnerabilities.
- They will learn how an individual user can become victim of cyber-attacks by just clicking on any malicious link

UNIT	CONTENTS	HOURS
I.	**Introduction to Ethical Hacking:** Introduction, Preparation, Penetration testing, Network penetration testing, Gaining access, Post exploitation, Website penetration testing, Protecting your system, What is hacking?, Why should we learn about hacking?, A glimpse of hacking, Browser exploitation framework, Accessing the target computer's webcam	10
II.	**System Setup for Kali:** Setting Up A Lab, Lab overview, VirtualBox, Installation of VirtualBox, Installing Kali Linux, Installing Metasploitable, Installing Windows, Creating and using snapshots. **Linux Basics:** Overview of Kali Linux, Status bar icons, Connecting the wireless card, Linux commands, Commands, The ls command, The man command, The help command, The Tab button	10
III.	**Network Penetration Testing:** What is a network?, Network basics, Connecting to a wireless adapter, MAC addresses, Wireless modes – managed and monitor, Enabling monitor mode manually, Enabling monitor mode using airmon-ng	9
IV.	**Pre-Connection Attacks:** Packet sniffing basics, Targeted packet sniffing, Deauthentication attack, Fake access point, Creating fake access points with the MANA Toolkit	8
V.	**Network Penetration Testing:** Network Penetration Testing, Gaining Access, WEP theory, Basic web cracking, Fake authentication attack, ARP request replay, WPA introduction, WPS cracking, Handshake theory, Capturing the handshake, Creating a wordlist, Wordlist cracking, Securing network from attacks, Post-connection attacks, The netdiscover tool, The AutoScan tool, Zenmap	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Evaluate the security of and identify vulnerabilities in target systems, networks or system infrastructure.
CO 2	Exploit vulnerabilities to determine whether unauthorized access or other malicious activities are possible
CO 3	
CO 4	
CO 5	
Text Books	• The Basics of Hacking and Penetration Testing is written by Patrick Engebretson

COURSE CODE	MICROPROCESSOR AND INTERFACING	Total Lecture: 45 Practical: 15
CS23B604		(LTP=3-0-2=4)

Course Objectives:

- To develop an in-depth understanding of the operations of microprocessors.
- To create an exposure to basic peripherals, its programming and interfacing techniques.
- To impart the basic concepts of serial communication in 8086

UNIT	CONTENTS	HOURS
I.	**8086 architecture:** 8086 architecture, functional diagram, register organization, memory segmentation, programming model, memory addresses, physical memory organization, signal descriptions of 8086, common function signals, timing diagrams, Interrupts of 8086.	10
II.	**Instruction set and assembly language programming of 8086** Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.	10
III.	**I/O interface:** 8255 PPI, various modes of operation and interfacing to 8086, interfacing of keyboard, display, stepper motor interfacing, D/A & A/D converter. Interfacing with advanced devices, memory interfacing to 8086, interrupts of 8086, vector interrupt table, interrupt service routine, serial communication standards, serial data transfer schemes, 82 51 USART architecture and Interfacing.	9
IV.	**Introduction to microcontrollers:** Overview of 8051 microcontroller, architecture, I/O ports, memory organization, addressing modes, instruction set of 8051, simple programs.	8
V.	**8051 real-time control:** Programming timer interrupts, programming external hardware interrupts, programming the serial communication interrupts, programming 8051 timers and counters.	8

List of Experiments:

1. Write a program for addition of two 16-bit numbers
2. Write a program for subtraction of two 16-bit numbers
3. Write a program for multiplication of two 16-bit numbers
4. Write a program for division of two 16-bit numbers
5. Write program to sort the given numbers in ascending and descending order
6. Write a program to search a number or character from a string
7. Write a program for transfer block of data from one memory location to another memory location
8. Write a program to reverse a given string
9. Write a program for conversion of analog data to digital output
10. Write a program for conversion of digital data to analog output

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Understand**[2] the architecture of microprocessor and microcontroller
CO 2	**Understand**[2] the programming model of microprocessor and microcontroller
CO 3	**Interface**[6] different external peripheral devices with microprocessors and microcontrollers
CO 4	**Analyze**[4] a problem and **formulate**[6] appropriate computing solution for processor or controller-based applications
CO 5	**Develop**[6] assembly language programs for specified applications
Text Books	• D V Hall, **Microprocessors and Interfacing**, Tata McGraw Hill, 2nd edition. • A K Ray and K M Bhurchandani, **Advanced Microprocessors and Peripherals**, Tata McGraw Hill, 2nd edition, 2006.
Reference Books	• K Uma Rao and Andhe Pallavi, **The 8051 Microcontrollers, Architecture and Programming and Applications**, Pearson Education, 2009. • Liu and GA Gibson, **Microcomputer system 8086/8088 Family Architecture, Programming and Design**, PHI, 2nd edition. • Kenneth J Ayala, **The 8051 Microcontroller**, Cengage Learning, 3rd edition, 2010.

COURSE CODE	MOBILE FORENSIC	Total Lecture: 45 Practical: 15
CY23B701		(LTP=3-0-2=4)

Course Objectives:

- Brief history of mobile devices
- Mobile device operating systems
- Best practices for capturing and preserving a mobile device
- Acquiring data from a mobile device
- Tools and demos for mobile device forensics
- Searching a mobile device
- Computer forensics reporting for mobile device

UNIT	CONTENTS	HOURS
I.	**Introduction to Mobile Forensic:** why mobile forensic, what is mobile forensic, challenges, evidence extraction process, evidence intake phase, identification phase, preparation, isolation, processing, verification, documenting and archiving phases, mobile forensic approaches, mobile operating systems, leveling system, data acquisition, evidences, examination and analysis, rule of evidence, good forensic practices	10
II.	**Android Forensic:** Understanding Android, evolution of android, android architecture, Linux kernel layer, hardware abstraction layer, libraries, Dalvik virtual machines, ART, Java API framework layer, system app layer, android security, secure kernel, permission model, application sandbox, secure IPC, application signing, security enhanced Linux SELinux, FDE, Android Keystore, TEE, Verified Boot, Android File hierarchy, android file system	10
III.	**Android Forensic Setup and Data Extraction:** Android Forensic Setup and Pre-Data Extraction Techniques, setting up forensic environment, installing software, installing android platform tool, create android virtual device, connect android device to workstation, device cable, install drivers, assess connected devices, android debug bridge, assess device using adb, handling android device, Screen lock bypass techniques, Gaining root access	9
IV.	**Android Data Extraction Techniques:** Understanding data extraction techniques, Manual data extraction, Logical data extraction, Physical data extraction, imaging an Android device and SD card, JTAG, and chip-off techniques, Analyzing and extracting data from Android image files using the Autopsy tool, Recover deleted files from an SD card and the internal memory, Android App Analysis, Malware, and Reverse Engineering	8
V.		8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Foundational concepts about the mobile computer forensics field
CO 2	Best practices for capturing and preserving a mobile device
CO 3	Searching a mobile device
CO 4	Fundamentals of how tools for mobile device forensics work
CO 5	Incorporating mobile forensics devices into your reports.
Text Books	• Digital forensic process The Ultimate Step-By-Step Guide Gerardus Blokdyk • Learn Computer Forensics William Oettinger

COURSE CODE	CYBER ATTACKS AND DEFENSE STRATEGIES	Total Lecture: 45 Practical: 15
CY23B702		(LTP=3-0-2=4)

Course Objectives:

- The objective of this course is to teach students the concepts of Cyber-attacks and defense strategies

UNIT	CONTENTS	HOURS
I.	**Security Posture:** The current threat landscape, the credentials – authentication and authorization, Applications, Data Protection, Cybersecurity Challenges, Older Techniques and Broader results, shift in threat landscape, Enhance security posture, Role of Blue Team and Red Team	10
II.	**Cybersecurity Kill Chain:** External reconnaissance, Scanning, Nmap, Metasploit, John the Ripper, THC Hydra, Wireshark, Aircrack-ng, Nikato, Kismet, Cain and Abel, Access and privilege escalation, Vertical privilege escalation, Horizontal privilege escalation, Exfiltration, Sustainment, Assault, Obfuscation, Threat life cycle management,	10
III.	**Reconnaissance:** External reconnaissance, Dumpster diving, social media, social engineering, Pretexting, Diversion theft, Phishing, Phone phishing (vishing), Spear phishing, Water holing, Baiting, Quid pro quo, Tailgating, Internal reconnaissance, Sniffing and scanning, Prismdump, tcpdump, NMap, Wireshark, Scanrand, Cain and Abel, Nessus, Metasploit, Wardriving,	9
IV.	**Compromising the System:** Analyzing current trends, Extortion attacks, Data manipulation attacks, IoT device attacks, Backdoors, Mobile device attacks, Hacking everyday devices, Hacking the cloud, Phishing, Exploiting a vulnerability, Zero-day, Fuzzing, Source code analysis, Types of zero-day exploits, Buffer overflows.	8
V.	**Structured exception handler** overwrites, Performing the steps to compromise a system, Deploying payloads, Installing and using a vulnerability scanner, Using Metasploit, Compromising operating systems, Compromising systems using Kon-Boot or Hiren's BootCD, Compromising systems using a Linux Live CD, Compromising systems using preinstalled applications, Compromising systems using Ophcrack, Compromising a remote system, Compromising web-based systems, SQL injection, Cross-site scripting, Broken authentication, DDoS attacks	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	**Understand**[1] security and networking foundations.
CO 2	**Recognize**[1] network defence tactics.
CO 3	**Apply**[3] cybersecurity strategy, cyber operations and security risk management.
CO 4	**Relate**[4] national cybersecurity strategy and action plan .
CO 5	**Understand**[1] basic attacks, vulnerability and steps to compromise the system.
Text Books	• Diogenes Yuri , Ozkaya Dr.Erdal, (2019): **Cybersecurity – Attack and Defense Strategies** , Second Edition: Packt Publisher

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

Discipline Specific Electives (DSE)
Data Analytics

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	INTRODUCTION TO DATA ANALYTICS	Total Lecture: 45 Practical: 15
DA23B101		(LTP=3-0-2=4)

Course Objectives:
In this course, students will gain a solid foundation in data analytics, covering key concepts, tools, and techniques. They will develop the skills to analyze and interpret data, understand its role in different industries, and make informed decisions based on data-driven insights

UNIT	CONTENTS	HOURS
I.	Definition and importance of data analytics, Applications of data analytics in various industries, Overview of the data analytics lifecycle	10
II.	Understanding structured, unstructured, and semi-structured data, Sources and characteristics of different data types, Data collection and preprocessing techniques	10
III.	Exploratory data analysis techniques, Data cleaning and handling missing values, Data visualisation principles and best practices	9
IV.	Descriptive statistics: measures of central tendency and variability, Inferential statistics: hypothesis testing and confidence intervals, Correlation and regression analysis	8
V.	Interpreting and drawing insights from data analysis results, Communicating data-driven insights, effectively through visualizations and reports, Ethical considerations and responsible data communication	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate a comprehensive understanding of the fundamental concepts and principles of data analytics.
CO 2	Apply various tools and techniques of data analytics to analyze and interpret data effectively.
CO 3	Recognize the significance of data analytics in different industries and domains, and evaluate its impact on decision-making processes.
CO 4	Utilize statistical analysis methods and data visualisation techniques to communicate insights derived from data analysis.
CO 5	Exhibit critical thinking and problem-solving skills by identifying and framing data-driven business problems, and proposing data-centric solutions.
Text Books	• Data Analytics Made Accessible by Dr. Anil Maheshwari • Numsense! Data Science for the Layman: No Math Added by Annalyn Ng and Kenneth Soo
Reference Books	• Python for Everybody: Exploring Data in Python 3 by Dr. Charles Russell Severance

COURSE CODE	PROGRAMMING FOR DATA ANALYTICS IN PYTHON	Total Lecture: 45 Practical: 15
DA23B201		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a strong foundation in programming using Python for data analytics. Students will learn the fundamentals of Python programming language and its application in data manipulation, analysis, and visualization. The course aims to equip students with the skills to write efficient Python code, utilize relevant libraries and frameworks, and implement data analytics algorithms to extract insights from diverse datasets in various domains

UNIT	CONTENTS	HOURS
I.	Basics of Python programming language, including syntax, data types, variables, and control structures, Introduction to Python IDEs (Integrated Development Environments) and code editors, Writing and executing Python programs	10
II.	Introduction to Python libraries for data manipulation and analysis, such as NumPy and Pandas Data cleaning and preprocessing techniques using Python Exploratory data analysis and descriptive statistics using Python	10
III.	Introduction to data visualization libraries in Python, such as Matplotlib and Seaborn Creating various types of plots and charts to visualize data distributions, relationships, and trendsCustomizing visualizations and adding interactivity	9
IV.	Introduction to machine learning concepts and algorithms Implementing machine learning models using Python's scikit-learn library Training, evaluating, and fine-tuning machine learning models for data analytics tasks	8
V.	Introduction to advanced Python libraries for data analytics, such as TensorFlow or PyTorch for deep learning Utilising Python packages for natural language processing (NLP) or time series analysis Integration of Python with databases and web APIs for data retrieval and integration	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a solid understanding of Python programming language and its specific applications in data analytics, including data manipulation, analysis, and visualization.
CO 2	Acquire proficiency in writing efficient and modular Python code to perform various data analytics tasks, such as data preprocessing, exploratory data analysis, and statistical modelling.
CO 3	Apply Python libraries and frameworks, such as NumPy, Pandas, and Matplotlib, to effectively manipulate and analyze data, conduct statistical computations, and create visualizations
CO 4	Utilize Python's machine learning libraries, such as scikit-learn, for implementing predictive analytics models and conducting machine learning experiments
CO 5	Demonstrate the ability to apply Python programming concepts and techniques to solve real-world data analytics problems, effectively extracting insights from diverse datasets and presenting findings in a clear and meaningful manner.
Text Books	• Automate the Boring Stuff with Python (Practical Programming for Total Beginners) • Python Data Science Handbook: Tools and Techniques for Developers
Reference Books	• Python Crash Course: A Hands-On, Project-Based Introduction to Programming

COURSE CODE	STATISTICAL METHODS FOR DATA ANALYTICS	Total Lecture: 45 Practical: 15
DA23B202		(LTP=3-0-2=4)

Course Objectives:
The objective of this course is to provide students with a solid foundation in statistical methods for data analytics, enabling them to understand and apply statistical techniques to analyze and interpret data effectively in the context of data analytics projects

UNIT	CONTENTS	HOURS
I.	Measures of central tendency, Measures of dispersion,Graphical representation of data	10
II.	Principles of data visualization, Techniques for visualizing data using graphs, charts, and plots	10
III.	Techniques for analyzing and summarizing data, Identifying patterns and relationships in data	9
IV.	Handling missing values in data, Dealing with outliers in data, Data normalisation techniques	8
V.	Real-world examples and applications of descriptive statistics,Real-world examples and applications of data visualization techniques	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Understand the fundamental concepts of descriptive statistics and its role in data analytics, including measures of central tendency, dispersion, and graphical representation of data.
CO 2	Apply various techniques for data visualization to effectively communicate and present insights derived from data analytics, using graphs, charts, and plots.
CO 3	Perform exploratory data analysis to identify patterns, relationships, and anomalies in data, utilizing appropriate statistical techniques and tools.
CO 4	Demonstrate proficiency in data preprocessing techniques, such as handling missing values, outliers, and normalization, to ensure data quality and reliability for statistical analysis in data analytics projects.
CO 5	Analyze real-world datasets and apply statistical methods to extract meaningful insights, make informed decisions, and solve problems in the context of data analytics.
Text Books	• Think Stats By Allen B. Downey • The Signal and The Noise: Why most predictions fail but some don't By Nate Silver
Reference Books	• Statistics in Plain English By Timothy C. Urdan

COURSE CODE	DATA WRANGLING AND CLEANING	Total Lecture: 45 Practical: 15
DA23B301		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to equip students with the necessary skills and techniques to effectively wrangle and clean data for data analytics projects. Students will learn how to handle messy and unstructured data, perform data cleaning operations, and transform data into a structured and suitable format for analysis, ensuring the accuracy and reliability of the data used in data analytics workflows

UNIT	CONTENTS	HOURS
I.	Understanding the importance of data wrangling in data analytics,Identifying common data quality issues and challenges,Exploring the data wrangling process and its role in data preparation	10
II.	Data validation: Identifying and handling missing, inconsistent, or erroneous data. Data transformation: Converting data types, handling outliers, and addressing inconsistencies, Data integration: Resolving data conflicts and merging data from multiple sources	10
III.	Structuring data for analysis: Handling unstructured and semi-structured data, Data normalization: Standardizing data formats and units, Feature engineering: Creating new features from existing data	9
IV.	Introduction to data wrangling tools and platforms Utilizing programming languages (e.g., Python, R) for automating data cleaning processes Applying libraries and packages for efficient data wrangling tasks	8
V.	Real-world examples of data wrangling challenges and solutions, Applying data cleaning techniques to different datasets and domains, Evaluating the impact of data wrangling on downstream data analytics tasks	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop proficiency in identifying and addressing data quality issues by applying data wrangling techniques, ensuring the reliability and accuracy of data used in data analytics projects.
CO 2	Demonstrate the ability to effectively handle messy, unstructured, and inconsistent data through various data cleaning operations, including data validation, transformation, and integration
CO 3	Apply appropriate data transformation techniques to convert data into a structured format suitable for analysis, enabling efficient and meaningful data exploration and interpretation.
CO 4	Utilize data wrangling tools and programming languages to automate data cleaning processes and streamline data preparation for data analytics workflows.
CO 5	Analyse real-world datasets, perform data wrangling tasks, and validate data integrity, demonstrating the ability to make informed decisions and draw meaningful insights from cleaned and structured data.
Text Books	• Bad Data by Q. Ethan McCallum • Best Practices in Data Cleaning by Jason Osborne
Reference Books	• Data Wrangling with Python by Jacqueline Kazil

COURSE CODE	TOOLS AND TECHNIQUES FOR BUSINESS ANALYTICS	Total Lecture: 45 Practical: 15
DA23B302		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to familiarize students with the various tools and terminologies used in business analytics for data analytics projects. Students will gain an understanding of popular analytics tools, technologies, and platforms, as well as the relevant terminologies, enabling them to effectively apply these tools and communicate analytics insights in a business context. The course aims to equip students with the necessary skills to utilize business analytics tools and terminologies to drive data-driven decision-making and solve real-world business problems

UNIT	CONTENTS	HOURS
I.	Overview of popular business analytics tools and platforms, Understanding the functionalities and capabilities of tools like Tableau, Power BI, Excel, and others, Exploring the role of tools in data analysis, visualization, and reporting for business analytics	10
II.	Key terminologies and concepts used in business analytics Understanding terms related to data analysis, predictive modeling, key performance indicators (KPIs), and metrics Interpreting and effectively communicating analytics terminologies in a business context	10
III.	Exploring tools for data exploration, cleansing, and transformation Understanding data visualization tools and techniques for business analytics Leveraging tools to create interactive dashboards and reports for effective data-driven decision-making	9
IV.	Introduction to predictive analytics tools and algorithms, Utilizing tools for data modeling, regression analysis, and forecasting, Applying tools to generate insights and predictions for business analytics purposes	8
V.	Techniques for presenting and communicating analytics findings to business stakeholders Creating impactful visualizations and reports using business analytics tools Applying storytelling techniques to effectively communicate data-driven insights in a business context	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop proficiency in using popular business analytics tools and platforms, such as Tableau, Power BI, or Excel, to analyze and visualize data for business decision-making.
CO 2	Acquire a comprehensive understanding of key terminologies used in business analytics, enabling effective communication and collaboration with business stakeholders.
CO 3	Apply analytical techniques and tools to extract actionable insights from data, facilitating data-driven decision-making in a business context.
CO 4	Demonstrate the ability to perform descriptive and predictive analytics using appropriate tools and methodologies, providing valuable insights for business operations and strategy
CO 5	Utilize business analytics tools and terminologies to effectively communicate and present analytics findings to diverse audiences, including business executives and non-technical stakeholders
Text Books	• The Hundred-Page Machine Learning Book By Andriy Burkov • Too Big to Ignore: The Business Case for Big Data By Phil Simon
Reference Books	• Big Data: A Revolution That Will Transform How We Live, Work, and Think By Viktor Mayer-Schönberger and Kenneth Cukier

COURSE CODE	MACHINE LEARNING FOR DATA ANALYTICS	Total Lecture: 45 Practical: 15
DA23B401		(LTP=3-0-2=4)

Course Objectives:
The objective of this course is to provide students with a comprehensive understanding of machine learning techniques and their application in data analytics. Students will learn the principles, algorithms, and methodologies of machine learning, enabling them to apply supervised and unsupervised learning techniques to analyze and model complex datasets

UNIT	CONTENTS	HOURS
I.	Understanding the fundamentals of machine learning and its role in data analytics, Types of machine learning algorithms: supervised, unsupervised, and reinforcement learning, Overview of the machine learning process and workflow	10
II.	Linear regression, Logistic regression, Decision trees and random forests, Support vector machines Naive Bayes classifiers	10
III.	K-means clustering, Hierarchical clustering, Principal Component Analysis (PCA), Association rule mining	9
IV.	Evaluating model performance using metrics like accuracy, precision, recall, and F1-score Cross-validation techniques for model evaluation, Hyperparameter tuning and model optimization	8
V.	Predictive modeling and regression analysis, Classification and pattern recognition Anomaly detection and outlier analysis, Recommender systems and personalized recommendations	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a strong foundation in the principles and concepts of machine learning, including supervised and unsupervised learning, model selection, and evaluation techniques.
CO 2	Acquire proficiency in applying various machine learning algorithms and techniques to analyze and model complex datasets for predictive modeling and pattern recognition in data analytics.
CO 3	Apply feature engineering and data preprocessing techniques to prepare data for machine learning algorithms, ensuring data quality and improving model performance.
CO 4	Evaluate and assess the performance of machine learning models using appropriate evaluation metrics and techniques, enabling informed model selection and optimization.
CO 5	Utilize machine learning algorithms to make data-driven decisions, generate predictions, and extract actionable insights in the context of data analytics, contributing to effective problem-solving and informed decision-making processes
Text Books	• The Elements of Statistical Learning: Data Mining, Inference and Prediction ("ESL") Authors: Trevor Hastie, Robert Tibshirani, Jerome Friedman • Pattern Recognition and Machine Learning ("PRML") Author: Christopher Bishop
Reference Books	• Machine Learning: A Probabilistic Perspective by Authors: Kevin P. Murphy

COURSE CODE	DATA VISUALIZATION	Total Lecture: 45 Practical: 15
DA23B402		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with the knowledge and skills necessary to effectively visualize data for data analytics purposes. Students will learn the principles, techniques, and best practices of data visualization, enabling them to create compelling and meaningful visual representations of data to communicate insights, patterns, and trends. The course aims to equip students with the ability to leverage data visualization as a powerful tool for storytelling and decision-making in the context of data analytics projects.

UNIT	CONTENTS	HOURS
I.	Importance and benefits of data visualization in data analytics, Perception and cognition in data visualization,Principles of effective data visualization design	10
II.	Selection and use of visual elements (e.g., color, size, shape) for data representation, Gestalt principles and their application in data visualization, Design considerations for clarity, accuracy, and aesthetics in data visualizations	10
III.	Techniques for visually exploring and understanding datasets, Tools and libraries for interactive data visualization, Visualizing distributions, correlations, and outliers in data	9
IV.	Time series visualization and temporal data analysis, Geospatial visualization and mapping techniques, Network visualization for analyzing relationships and connections in data	8
V.	Principles of effective data storytelling,Designing interactive dashboards for data exploration and communication, Incorporating narratives and context in data visualizations	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a deep understanding of the principles and concepts of data visualization, including the perception of visual information, effective use of visual elements, and storytelling through data.
CO 2	Acquire proficiency in utilizing a wide range of data visualization techniques, tools, and libraries to create impactful visual representations of data for analysis and communication purposes.
CO 3	Apply best practices in data visualization design to effectively communicate insights, patterns, and trends in data, ensuring clarity, accuracy, and accessibility for diverse audiences.
CO 4	Analyze and evaluate the effectiveness of different data visualization approaches and techniques, selecting appropriate visualizations to address specific analytical and communication objectives.
CO 5	Utilize data visualization as a powerful tool for data exploration, analysis, and decision-making, effectively conveying complex information and enabling data-driven insights and actions.
Text Books	• Visualize This: The Flowing Data Guide To Design, Visualization, And Statistics By Nathan Yau • The Visual Display Of Quantitative Information By Edward R.Tufte
Reference Books	• "Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few

COURSE CODE	BIG DATA ANALYTICS	Total Lecture: 45 Practical: 15
DA23B501		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to equip students with the knowledge and skills required to analyze and process large volumes of data in the context of big data analytics. Students will learn the principles, technologies, and methodologies of big data analytics, including data storage, processing, and analysis using distributed systems and tools. The course aims to enable students to effectively utilize big data analytics techniques and platforms to derive valuable insights, solve complex problems, and make data-driven decisions in real-world scenarios.

UNIT	CONTENTS	HOURS
I.	Understanding the characteristics and challenges of big data analytics, Exploring the role of big data analytics in solving complex problems, Overview of big data analytics tools, platforms, and technologies	10
II.	Distributed file systems: Hadoop Distributed File System (HDFS), NoSQL databases: MongoDB, Cassandra, and others, Data ingestion and streaming frameworks: Apache Kafka, Apache NiFi	10
III.	Introduction to Apache Spark for large-scale data processing, Spark data transformations and actions, Advanced analytics with Spark: machine learning, graph processing	9
IV.	Handling structured and unstructured data in big data analytics Techniques for data cleaning, transformation, and integration Data quality assessment and improvement in big data environments	8
V.	Real-time analytics: stream processing and real-time decision-making, Text analytics and natural language processing for big data, Scalable data visualization and visual analytics in big data contexts	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a comprehensive understanding of the principles and concepts of big data analytics, including the challenges and opportunities associated with analyzing large volumes of data.
CO 2	Acquire proficiency in utilizing big data technologies and tools, such as Hadoop, Spark, and NoSQL databases, for data storage, processing, and analysis in distributed computing environments
CO 3	Apply data preprocessing and data integration techniques to handle and prepare big data for analytics, ensuring data quality and usability.
CO 4	Utilize advanced analytics algorithms and techniques, such as machine learning and data mining, to extract insights, patterns, and trends from large-scale datasets
CO 5	Demonstrate the ability to design and implement big data analytics workflows, perform scalable data processing and analysis, and communicate findings effectively, contributing to informed decision-making and value creation in a big data context.
Text Books	• Big Data and Analytics by Seema Acharya, Subhashini Chellappan • Big data analytics by Arvind Sathi
Reference Books	• Big Data Analytics Beyond Hadoop: Real-Time Applications with Storm, Spark and more Hadoop Alternatives BY VIJAY AGNEESWARAN

COURSE CODE	PREDICTIVE AND TIME SERIES ANALYTICS	Total Lecture: 45 Practical: 15
DA23B502		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a solid understanding of predictive analytics techniques and their application in data analytics. Students will learn the principles, methodologies, and tools for predictive modeling, enabling them to develop and deploy predictive models to make accurate predictions and forecast outcomes. The course aims to equip students with the skills to effectively leverage predictive analytics to solve real-world problems, identify patterns, and drive data-driven decision-making in diverse industries and domains

UNIT	CONTENTS	HOURS
I.	Understanding the fundamentals of predictive analytics and its role in data analytics, Key concepts: prediction, forecasting, and inference, Overview of predictive analytics workflow and methodologies	10
II.	Linear regression: simple and multiple regression models, Non-linear regression models, Assessing regression model performance and interpreting results Logistic regression for binary classification, Decision tree algorithms: ID3, C4.5, CART, Ensemble methods: Random Forest, Gradient Boosting	10
III.	Understanding time series data and its characteristics, Popular time series forecasting methods: ARIMA, Exponential Smoothing, Evaluating and improving time series forecast accuracy Performance metrics for predictive models: accuracy, precision, recall, ROC curves, Cross-validation techniques for model evaluation, Deploying predictive models in real-world scenarios	9
IV.	Understanding the characteristics and properties of time series data, Exploring different types of time series patterns: trend, seasonality, and cyclicity, Overview of time series analysis techniques and applications Techniques for visualizing and exploring time series data, Handling missing values and outliers in time series data, Time series decomposition methods: trend, seasonality, and residual analysis	8
V.	Introduction to Autoregressive Integrated Moving Average (ARIMA) models, Identification, estimation, and order selection for ARIMA models, Diagnostic checks and model validation for ARIMA models Exponential smoothing methods: Simple, Holt's, and Winter's methods, Adaptive exponential smoothing and trend estimation, Seasonal variations and seasonal exponential smoothing, State space models and Kalman filtering for time series analysis, Forecasting with dynamic regression models, Time series forecasting evaluation and accuracy measures	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a comprehensive understanding of predictive analytics concepts, including regression analysis, classification, and forecasting, to make accurate predictions and forecast future outcomes.
CO 2	Acquire proficiency in applying various predictive and time series analytics techniques, algorithms, and models to analyze and interpret data, enabling informed decision-making and proactive planning.
CO 3	Apply feature selection and feature engineering techniques to identify and extract relevant variables for predictive modeling, enhancing model performance and interpretability.
CO 4	Utilize predictive analytics models to generate insights, make data-driven predictions, and optimize business processes, contributing to improved decision-making and strategic planning in various domains.
CO 5	Demonstrate the ability to forecast future values, detect anomalies, and make data-driven decisions using time series analysis, contributing to improved forecasting accuracy and effective decision-making in various domains.
Text Books	• Predictive Analytics Using Statistics and Big Data: Concepts and Modeling by Arvind Pandey (Editor), Dharmendra Singh Rajput (Editor), Krishna Kumar Mohbey (Author) • The Analysis of Time Series: An Introduction" Author: Chris Chatfield • Time Series Analysis" Author: James Douglas Hamilton
Reference Books	• Practical Time Series Analysis: Prediction with Statistics and Machine Learning by Aileen Nielsen (Author) • Introduction to Time Series Analysis Mark Pickup - Simon Fraser University, Canada

COURSE CODE	DEEP LEARNING	Total Lecture: 45 Practical: 15
DA23B601		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of deep learning techniques and their application in data analytics. Students will learn the principles, methodologies, and algorithms of deep learning, enabling them to design and implement neural networks for various data analysis tasks. The course aims to equip students with the skills to effectively leverage deep learning models to extract complex patterns, solve challenging problems, and make data-driven decisions in diverse domains such as image recognition, natural language processing, and predictive modelling

UNIT	CONTENTS	HOURS
I.	Understanding the basics of deep learning, neural networks, and their applications in data analytics Overview of activation functions, loss functions, and optimization algorithms for training neural networks, Introduction to deep learning frameworks and libraries	10
II.	Fundamentals of CNN architecture, including convolutional layers, pooling layers, and fully connected layers, Techniques for training and fine-tuning CNNs for image recognition and computer vision tasks, Transfer learning with CNNs and leveraging pre-trained models	10
III.	Understanding sequential data and the need for recurrent neural networks, Architectures of RNNs, including LSTM (Long Short-Term Memory) and GRU (Gated Recurrent Unit), Applications of RNNs in natural language processing, time series analysis, and sequence generation	9
IV.	Introduction to generative models, including autoencoders and variational autoencoders (VAEs) Understanding the concept and architecture of generative adversarial networks (GANs) Applications of GANs in image generation, data synthesis, and anomaly detection	8
V.	Advanced optimization techniques, including learning rate schedules, batch normalization, and weight regularization, Attention mechanisms and transformer models for natural language processing tasks, Deep reinforcement learning and its applications in game playing and decision-making	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a solid understanding of deep learning concepts, including neural networks, activation functions, and optimization algorithms, to effectively design and train deep learning models for data analytics tasks.
CO 2	Acquire proficiency in implementing and utilizing various deep learning architectures, such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs), to solve complex problems in image analysis, natural language processing, and other domains.
CO 3	Apply transfer learning and fine-tuning techniques to leverage pre-trained deep learning models and adapt them to new data analysis tasks, enabling faster and more efficient model development.
CO 4	Utilize advanced techniques for model optimization, regularization, and hyperparameter tuning to improve the performance and generalization of deep learning models.
CO 5	Demonstrate the ability to deploy and utilize deep learning models in practical applications, contributing to the advancement of data analytics and the development of intelligent systems in various domains.
Text Books	• Speech and Language Processing by Authors: Daniel Jurafsky and James H. Martin • "Natural Language Understanding" by Author: James Allen
Reference Books	• "Handbook of Natural Language Processing" By Authors: Nitin Indurkhya and Fred J. Damerau

COURSE CODE	BUSINESS INTELLIGENCE	Total Lecture: 45 Practical: 15
DA23B602		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of business intelligence (BI) concepts and their application in data analytics. Students will learn the principles, methodologies, and tools for collecting, analyzing, and visualizing data to support business decision-making. The course aims to equip students with the skills to effectively utilize BI techniques, develop interactive dashboards, and generate actionable insights to drive organizational success in various domains and industries

UNIT	CONTENTS	HOURS
I.	Understanding the role and significance of business intelligence in data analytics, Overview of the business intelligence process, including data collection, data integration, data analysis, and data visualization, Introduction to key business intelligence tools and platforms	10
II.	Fundamentals of data warehousing and its role in business intelligence, Dimensional modeling techniques for designing efficient and effective data structures, Extract, Transform, Load (ETL) processes for integrating and managing data in a data warehouse	10
III.	Techniques for data analysis and mining, including descriptive, diagnostic, predictive, and prescriptive analytics, Utilizing statistical methods and machine learning algorithms for uncovering patterns and insights in data, Applying data analysis techniques to solve business problems and support decision-making	9
IV.	Principles of effective data visualization for business intelligence purposes, Tools and techniques for creating interactive dashboards and reports, Designing visually appealing and informative visualizations to communicate insights to stakeholders	8
V.	Exploring real-world business intelligence applications and use cases across various industries, Analyzing and interpreting business intelligence reports and insights, Applying business intelligence techniques to solve specific business challenges and drive organizational success	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a solid understanding of business intelligence concepts and methodologies, including data collection, data integration, data analysis, and data visualization, to support effective decision-making in organizations.
CO 2	Acquire proficiency in utilizing business intelligence tools and platforms, such as Tableau, Power BI, or Qlik, to extract, transform, and analyze data from various sources and generate meaningful insights.
CO 3	Apply data modeling techniques, including dimensional modeling and data cubes, to design efficient and scalable data structures for business intelligence applications
CO 4	Utilize advanced data visualization techniques to create interactive dashboards and reports that effectively communicate insights and enable stakeholders to make data-driven decisions.
CO 5	Demonstrate the ability to apply business intelligence principles and techniques to real-world business scenarios, effectively analyzing data, identifying trends, and providing actionable recommendations for improved business performance.
Text Books	• Business Analytics: The Science of Data-Driven Decision-Making Author: U Dinesh Kumar • Business Analytics: Applications to Consumer Marketing Authors: Sandhya Kuruganti, Hindol Basu
Reference Books	• Business Intelligence Guidebook: From Data Integration to Analytics Author: Rick Sherman

COURSE CODE	CLOUD COMPUTING FOR DATA ANALYTICS	Total Lecture: 45 Practical: 15
DA23B701		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of cloud computing concepts and their application in data analytics. Students will learn the principles, methodologies, and technologies for leveraging cloud infrastructure and services to store, process, and analyze large-scale data. The course aims to equip students with the skills to effectively utilize cloud computing platforms, deploy data analytics workflows, and leverage scalable resources for efficient data analysis and decision-making in various domains.

UNIT	CONTENTS	HOURS
I.	Understanding the fundamentals of cloud computing and its relevance in data analytics, Overview of cloud service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), Cloud deployment models: Public cloud, private cloud, and hybrid cloud	10
II.	Cloud-based storage options: Object storage, block storage, and file storage, Data security, encryption, and access control in the cloud, Data lifecycle management and backup strategies in cloud environments	10
III.	Introduction to cloud service providers (AWS, Azure, GCP) and their offerings for data analytics Utilizing cloud-based databases and data warehousing solutions for storing and managing structured and unstructured data Leveraging cloud-based big data platforms and frameworks for scalable data processing and analysis	9
IV.	Introduction to cloud-native data analytics tools, such as Apache Spark, Hadoop, and data lakes Exploring serverless computing and its applications in data analytics workflows Real-time data processing and streaming analytics using cloud-based services	8
V.	Designing and deploying cloud-based data analytics architectures Scalability and elasticity considerations for handling large-scale data analytics workloads Monitoring, performance optimization, and cost management in cloud environments	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a solid understanding of cloud computing concepts, including virtualization, scalability, and elasticity, to effectively leverage cloud infrastructure for data analytics tasks
CO 2	Acquire proficiency in utilizing cloud computing platforms, such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP), for storing, processing, and analyzing large-scale datasets.
CO 3	Apply cloud-based data storage and retrieval techniques, including object storage and database services, to efficiently manage and access data for analytics purposes.
CO 4	Utilize cloud-based data processing and analytics services, such as Apache Spark, Hadoop, or serverless computing frameworks, to perform scalable and distributed data analysis
CO 5	Demonstrate the ability to design and implement cloud-based data analytics workflows, utilizing cloud-native tools and services, and effectively leverage cloud resources to support data-driven decision-making in various domains.
Text Books	• Cloud Computing: Concepts, Technology and Architecture" by Thomas Erl and Ricardo Puttini • Computing for Data Analysis: Theory and Practices Authors: Sanjay Chakraborty , Lopamudra Dey
Reference Books	• Cloud Computing For Dummies by Judith Hurwitz

COURSE CODE	NATURAL LANGUAGE PROCESSING	Total Lecture: 45 Practical: 15
DA23B702		(LTP=3-0-2=4)

Course Objectives:

The objective of this course is to provide students with a comprehensive understanding of natural language processing (NLP) techniques and their application in data analytics. Students will learn the principles, methodologies, and algorithms for processing and analyzing textual data, enabling them to extract meaningful information, perform sentiment analysis, and develop language-based models

UNIT	CONTENTS	HOURS
I.	Understanding the fundamentals of natural language processing and its significance in data analytics, Overview of text preprocessing techniques, including tokenization, stemming, and stop-word removal, Introduction to language models and text corpora	10
II.	Techniques for text classification, including Naive Bayes, Support Vector Machines, and deep learning approaches, Sentiment analysis methods for determining sentiment polarity in textual data, Handling imbalanced datasets and evaluating classification performance	10
III.	Approaches for named entity recognition, including rule-based and machine learning methods, Extraction of structured information from unstructured text using information extraction techniques, Relation extraction and knowledge base population from textual data	9
IV.	Latent Dirichlet Allocation (LDA) and other topic modeling algorithms for discovering latent topics in text, Techniques for text summarization, including extractive and abstractive methods, Evaluating topic models and summarization quality metrics	8
V.	Word embeddings: word2vec, GloVe, and contextual embeddings, Neural network architectures for language modelling and text generation, Machine translation, question answering systems, and dialogue generation	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop a solid understanding of natural language processing (NLP) concepts, including text preprocessing, tokenization, part-of-speech tagging, and syntactic parsing, to effectively analyze and process textual data.
CO 2	Acquire proficiency in applying various NLP techniques, such as named entity recognition, sentiment analysis, topic modeling, and text classification, to extract meaningful insights and patterns from textual data
CO 3	Utilize advanced NLP algorithms and models, including word embeddings and language models, for tasks such as text generation, machine translation, and question answering
CO 4	Apply NLP techniques to perform text mining and information extraction from unstructured textual data, enabling data-driven decision-making and knowledge discovery.
CO 5	Demonstrate the ability to design and develop NLP applications, including chatbots, text summarization systems, and sentiment analysis tools, contributing to the advancement of natural language processing and its applications in data analytics.
Text Books	• Speech and Language Processing by Authors: Daniel Jurafsky and James H. Martin • "Natural Language Understanding" by Author: James Allen
Reference Books	• "Handbook of Natural Language Processing" By Authors: Nitin Indurkhya and Fred J. Damerau

SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL

Syllabus

for

Bachelor of Technology (Honors)

Computer Science and Engineering

Discipline Specific Electives (DSE)
Cloud Computing

for Batch 2024 Onwards
(Under CBCS System)

Department of Advanced Computing

wef 2024-25

COURSE CODE	FOUNDATIONS OF COMPUTING	Total Lecture: 45 Practical: 15
CC23B101		(LTP=3-0-2=4)

Course Objectives:

The course "Fundamentals of Computing" aims to provide students with a strong foundation in computer science, algorithms, programming languages, data structures, and software development methodologies. Students will develop problem-solving skills and the ability to apply these concepts to the specific context of cloud computing. The course also emphasises teamwork and collaboration.

UNIT	CONTENTS	HOURS
I.	Introduction to Computer Science:Overview of computer science as a discipline,History of computer science,Importance of computer science in various fields,Introduction to algorithms,Introduction to data structures,Computer architecture,Role of operating systems	10
II.	Basics of Programming:Introduction to programming fundamentals, High-level languages (e.g., Python or Java), Variables, Data types, Control structures (e.g., if statements, loops), Functions, Basic input/output operations, Hands-on programming exercises, Problem-solving tasks	10
III.	Algorithms and Problem Solving: Study of fundamental algorithms Problem-solving techniques,Algorithm analysis, Searching algorithms, Sorting algorithms, Recursion,Basic algorithmic strategies (e.g., divide and conquer, greedy algorithms), Emphasis on algorithmic efficiencyImplementing algorithms in code	9
IV.	Data Structures and their Applications:Introduction to data structures, Arrays, Linked lists, Stacks, Queues, Trees, Graphs, Properties and operations of data structures, Use cases for different data structure,. Applications of data structures in solving real-world problems	8
V.	Introduction to Computer Systems and Networks:Introduction to computer systems, Hardware components of a computer system, Operating systems and their functions, Introduction to computer networks, Layers of network protocols (e.g., OSI model, TCP/IP), Network topologies,Basics of network security, Overview of distributed system, Introduction to cloud computing and its concepts	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Discuss and apply fundamental concepts of computer science, including the architecture of computers, memory management, and operating systems, in the context of cloud computing.
CO 2	Analyze problems, design efficient algorithms, and implement them using appropriate programming constructs, demonstrating proficiency in programming languages commonly used in cloud computing
CO 3	Select and implement appropriate data structures, such as arrays, linked lists, trees, and graphs, to solve real-world problems encountered in cloud computing
CO 4	Demonstrate an understanding of software development methodologies, including the software development life cycle, version control, testing, and documentation, and apply these principles to cloud computing projects.
CO 5	Collaborate effectively in teams, communicate technical concepts clearly, and demonstrate problem-solving and critical thinking skills in the context of cloud computing
Text Books	• Cloud Computing: Concepts, Technology & Architecture by Erl (Author) • Cloud Computing: Concepts, Technology & Architecture by Thomas Erl and Ricardo Puttini
Reference Books	• Cloud Computing For Dummies by Judith Hurwitz • Cloud Computing: From Beginning to End by Mr Ray J Rafaels

COURSE CODE	SOFTWARE DEVELOPMENT AND WEB TECHNOLOGIES	Total Lecture: 45 Practical: 15
CC23B201		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Software Development and Web Technologies" is to provide students with a strong foundation in software development principles, object-oriented programming, and web technologies. The course aims to equip students with the skills necessary to design, develop, test, and deploy web applications using industry-standard programming languages, frameworks, and tools while adhering to software engineering best practices for cloud computing environments.

UNIT	CONTENTS	HOURS
I.	Object-Oriented Programming and Design Patterns: Introduction to object-oriented programming (OOP) concepts, Classes and objects, Inheritance and polymorphism,Encapsulation and data hiding, Introduction to design patterns, Commonly used design patterns (e.g., Singleton, Observer, Factory), Application of design patterns in software development,Creating modular, reusable, and maintainable code using OOP and design patterns	10
II.	Software Engineering Principles and Practices: Overview of software engineering principles, Software engineering practices in the context of cloud computing, Requirements analysis and gathering, System design and architecture, Coding standards and best practices, Version control systems, Documentation practices, Software development life cycle (SDLC), Introduction to agile methodologies (e.g., Scrum, Kanban), Applying agile methodologies in software development	10
III.	Web Development Fundamentals (HTML, CSS, JavaScript):Introduction to web technologies, HTML (Hypertext Markup Language), Creating and structuring web pages with HTML, Understanding HTML tags, elements, and attributes, Semantic HTML and accessibility, CSS (Cascading Style Sheets), JavaScript, Introduction to JavaScript, Adding interactivity and behavior to web pages, Variables, data types, and operators in JavaScript, DOM manipulation and event handling, JavaScript libraries and frameworks (optional), Web standards and browser compatibility, Introduction to responsive design principles	9
IV.	Web Application Frameworks and Libraries:Introduction to web application frameworks and libraries, Overview of popular web application frameworks (e.g., React, Angular, Django),Simplifying web application development with frameworks, Handling routing and navigation in web applications, Managing state in web applications, Enhancing user experience with frameworks and libraries, Exploring additional features and functionalities provided by specific frameworks Building web applications using the chosen framework or library	8
V.	Software Testing and Quality Assurance: Introduction to software testing methodologies, Quality assurance techniques for web applications in cloud computing, Unit testing: Testing individual components or units of code, Integration testing: Testing the interaction between different components/modules, Functional testing: Verifying the functional requirements of the software, Performance testing: Assessing the performance and scalability of web applications, Security testing: Identifying vulnerabilities and ensuring application security, Bug tracking and defect management Test automation: Automating test cases for efficiency and repeatability,Code quality analysis: Assessing the quality of code through static analysis tools and metric	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate proficiency in object-oriented programming and design patterns for developing robust and maintainable software solutions in cloud computing.
CO 2	Apply software engineering principles and practices to develop high-quality software projects for cloud-based environments.
CO 3	Develop web applications with HTML, CSS, and JavaScript, incorporating interactivity, responsiveness, and accessibility, while considering user experience (UX) design.
CO 4	Utilize web application frameworks and libraries to expedite development, improve code organization, and enhance functionality and user experience in cloud computing.

CO 5	Implement software testing and quality assurance techniques to ensure reliability, functionality, and security of web applications in the cloud, including unit testing, integration testing, and debugging.
Text Books	• Object-Oriented Programming with C++ by Balagurusamy • Software Engineering: Principles and Practices by Naresh Chauhan. • Web Technologies: HTML, CSS, JavaScript, XML, PHP, and MySQL by Uttam Kumar Roy

COURSE CODE	INTRODUCTION TO CLOUD COMPUTING	Total Lecture: 45 Practical: 15
CC23B202		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Introduction to Cloud Computing" is to provide students with a comprehensive understanding of cloud computing concepts, service models, deployment models, infrastructure, and economics. The course aims to equip students with the knowledge and skills necessary to comprehend the fundamentals of cloud computing, evaluate different cloud service and deployment models, understand cloud infrastructure and virtualization technologies, and optimise costs in cloud environments

UNIT	CONTENTS	HOURS
I.	Fundamental concepts and principles of cloud computing, Definition, characteristics, and historical development of cloud computing, Evolution of cloud computing and its impact on the IT industry	10
II.	Cloud Service Models (SaaS, PaaS, IaaS): Software as a Service (SaaS) model, Features, benefits, and use cases,Examples of popular SaaS offerings, Platform as a Service (PaaS) model, Features, benefits, and use cases, Examples of popular PaaS offerings,Infrastructure as a Service (IaaS) model Features, benefits, and use cases,Examples of popular IaaS offerings	10
III.	Cloud Deployment Models (Public, Private, Hybrid): Public cloud deployment model, Ownership, control, and infrastructure sharing aspects, Advantages, considerations, and use cases, Private cloud deployment model, Ownership, control, and infrastructure isolation aspects,Advantages, considerations, and use cases, Hybrid cloud deployment model, Combining public and private cloud environments Advantages, considerations, and use cases	9
IV.	Cloud Infrastructure and Virtualization: Cloud infrastructure components and technologies, Virtualization, server clusters, storage systems, networking,Role of virtualization in cloud computing Benefits of virtualization in terms of resource utilization, scalability, flexibility	8
V.	Cloud Economics and Cost Optimization: Cloud economics and pricing models, Different pricing models offered by cloud providers, Cost factors and estimation of cloud costs, Cost optimization strategies in the cloud, Rightsizing resources,Utilizing spot instances, Leveraging auto-scaling capabilities, Other cost optimization techniques	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate a thorough understanding of cloud computing concepts, components, and characteristics.
CO 2	Evaluate and compare cloud service and deployment models for effective application and service deployment.
CO 3	Proficiently set up and manage virtualized cloud environments using infrastructure components and virtualization technologies.
CO 4	Apply cloud economics principles to optimize costs and resource provisioning in cloud computing.
CO 5	Analyze and address security and compliance considerations in cloud environments, implementing appropriate measures to protect data and ensure regulatory compliance.
Text Books	• Cloud Computing: Concepts, Technology & Architecture by Dr. Rajkumar Buyya, Dr. S. Thamarai Selvi, and Dr. Xingchen Chu • Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski
Reference Books	• Cloud Computing: A Practical Approach by Shreekant W. Shiralkar

COURSE CODE	CLOUD INFRASTRUCTURES AND SERVICES	Total Lecture: 45 Practical: 15
CC23B301		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Cloud Strategy and Management" is to provide students with the knowledge and skills to develop effective cloud strategies and manage cloud environments. The course aims to equip students with a comprehensive understanding of IoT integration with cloud computing, cloud migration strategies and planning, cost management and optimization techniques, cloud governance and risk management practices, and monitoring cloud service performance through SLAs

UNIT	CONTENTS	HOURS
I.	Internet of Things (IoT) and its Integration with Cloud Computing:Introduction to IoT and its relationship with cloud computing, Data generation and transmission from IoT devices to the cloud, Integration of IoT platforms and services with cloud infrastructure, Real-world IoT use cases and their implementation in cloud environments	10
II.	Cloud Migration Strategies and Planning: Overview of cloud migration strategies and planning, Assessment of existing infrastructure, applications, and data for cloud migration, Different migration approaches (lift-and-shift, re-platforming, re-architecting), Considerations for data migration, security, and performance during migration	10
III.	Cloud Cost Management and Optimization:Techniques for cloud cost management and optimizatio, Understanding cloud pricing models, cost allocation, and resource utilization tracking, Cost optimization strategies (rightsizing, auto-scaling, reserved instances), Best practices for optimizing cloud costs while maintaining performance and scalability	9
IV.	Cloud Governance and Risk Management: Introduction to cloud governance frameworks and practices, Cloud policies, compliance, and security in cloud environments, Risk management strategies in cloud computing (data privacy, access controls, disaster recovery), Regulatory requirements and industry standards for cloud governance	8
V.	Cloud Service Level Agreements (SLAs) and Performance Monitoring: Overview of cloud service level agreements (SLAs),. Components of SLAs and their role in ensuring service quality and availability, Monitoring and measuring cloud service performance (uptime, response time, scalability), Tools and techniques for proactive monitoring, performance optimization, incident management	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Develop an understanding of integrating IoT with cloud computing, including data generation and processing in the cloud, and designing and managing IoT systems using cloud platforms.
CO 2	Acquire expertise in cloud migration strategies and planning, assessing requirements, evaluating infrastructure, and implementing effective migration strategies.
CO 3	Gain proficiency in cloud cost management and optimization techniques, analyzing usage patterns, identifying cost drivers, and implementing strategies to minimize costs.
CO 4	Develop knowledge and skills in cloud governance and risk management, establishing frameworks, policies, and procedures for compliance, security, and privacy.
CO 5	Gain insights into cloud service level agreements (SLAs) and performance monitoring, understanding their components and implementing monitoring systems for reliable service performance.
Text Books	• Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood • Cloud Strategy: A Decision-Making Guide for Executives and IT Professionals" by Gregor Petri and Ben Grimes.
Reference Books	• Cloud Computing for Business: The Open Group Guide" by Mike Walker, Chris Harding, and Roberta J. Witty.

COURSE CODE	CLOUD INFRASTRUCTURE AND SERVICES	Total Lecture: 45 Practical: 15
CC23B302		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Cloud Infrastructure and Services" is to provide students with a comprehensive understanding of cloud architecture, design principles, and the key components of cloud infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS). The course aims to equip students with the knowledge and skills necessary to design, implement, and utilize cloud services using popular cloud providers and technologies such as AWS, while understanding the benefits and considerations associated with different service models in cloud computing.

UNIT	CONTENTS	HOURS
I.	Cloud Architecture and Design Principles: Principles and concepts of cloud architecture, Scalability, elasticity, fault tolerance, and security in cloud architecture, Architectural patterns for cloud-based applications, Designing cloud infrastructure to meet specific requirements and optimize performance	10
II.	Cloud Providers and Technologies (e.g., AWS, Azure, GCP): Exploring popular cloud providers (e.g., AWS, Azure, GCP), Features, services, and tools offered by cloud providers, Navigating the cloud provider console, Provisioning resources and managing cloud services	10
III.	Infrastructure as a Service (IaaS) and its Components: Understanding Infrastructure as a Service (IaaS) concept,Key components of IaaS (virtual machines, storage, networking, security), Provisioning and managing IaaS resources, Configuring networking and implementing security measures in a cloud environment	9
IV.	Platform as a Service (PaaS) and its Implementation:Exploring Platform as a Service (PaaS) in cloud computing, PaaS offerings (application platforms, databases, developer tools, container services), Deployment, management, and scaling of applications on PaaS platforms	8
V.	Software as a Service (SaaS) and its Benefits: Understanding Software as a Service (SaaS) concept, Benefits of SaaS in cloud computing (reduced maintenance, accessibility, scalability),Exploring various SaaS applications, Evaluating and integrating SaaS solutions into cloud environment	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate understanding of cloud architecture and design principles for scalable, reliable, and secure cloud infrastructures.
CO 2	Effectively utilize and navigate cloud provider platforms like AWS to deploy, manage, and monitor cloud infrastructure and services.
CO 3	Proficiently provision and manage Infrastructure as a Service (IaaS) resources, including virtual machines, storage, networking, and security in cloud environments.
CO 4	Implement and deploy Platform as a Service (PaaS) solutions, utilizing cloud provider services and tools for application development, deployment, and scalability.
CO 5	Evaluate and utilize Software as a Service (SaaS) solutions, integrating and configuring them within a cloud computing environment based on specific business needs.
Text Books	• Cloud Computing: A Practical Approach by Shreekant W. Shiralkar. • Cloud Computing: Concepts, Technology & Architecture by Dr. Rajkumar Buyya, Dr. S. Thamarai Selvi, and Dr. Xingchen Chu
Reference Books	• Cloud Computing: A Hands-On Approach by Arvind S. Krishna, Srividya Gundala, and Prasad Calyam.

COURSE CODE	DATA STORAGE AND MANAGEMENT IN CLOUD	Total Lecture: 45 Practical: 15
CC23B401		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Data Storage and Management in the Cloud" is to provide students with a comprehensive understanding of cloud-based data storage technologies, including NoSQL databases, cloud data warehousing, and cloud file systems like Google File System (GFS), Hadoop Distributed File System (HDFS), MapReduce, and BigQuery. The course aims to equip students with the knowledge and skills necessary to design, implement, and manage data storage solutions in the cloud, including data replication, backup strategies, and ensuring data governance and compliance in cloud environments

UNIT	CONTENTS	HOURS
I.	Cloud-Based Data Storage Technologies:Cloud file systems (e.g., Google File System, Hadoop Distributed File System),. Principles, architecture, and benefits of cloud file systems, Storing and accessing large volumes of data in cloud environments	10
II.	NoSQL Databases and their Use Cases:Concepts and characteristics of NoSQL databases in cloud computing,Types of NoSQL databases (key-value stores, document databases, graph databases), Use cases and advantages of NoSQL databases over relational databases	10
III.	Cloud Data Warehousing and Business Intelligence:Cloud data warehousing concepts and tools, ETL (Extraction, Transformation, and Loading) process in cloud data warehouses, Business intelligence techniques for data analysis, reporting, and visualization	9
IV.	Data Replication and Backup Strategies:Cloud file systems (e.g., Google File System, Hadoop Distributed File System) for big data storage and processing, MapReduce programming model for distributed processing of large datasets,. Architecture and benefits of using cloud-based file systems and MapReduce in big data analytics	8
V.	Data Governance and Compliance in the Cloud:Exploring Google BigQuery, a cloud-based data warehouse and analytics platform, Architecture, features, and benefits of BigQuery for analyzing large datasets in the cloud, Writing SQL-like queries in BigQuery for data retrieval, transformation, and analysis, Integration of BigQuery with other cloud services for advanced analytics and machine learning	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Explain and evaluate cloud-based data storage technologies
CO 2	Apply NoSQL databases for scalable and flexible data management.
CO 3	Design and implement cloud data warehousing solutions.
CO 4	Develop strategies for data replication, backup, and disaster recovery.
CO 5	Discuss about data governance and compliance challenges in the cloud
Text Books	• Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg, and Andrzej Goscinski. • Data Warehousing in the Age of Big Data by Krish Krishnan
Reference Books	• .Cloud Data Management by Marko H. Hämäläinen, Sherif Sakr, and Sushmita Ruj.

COURSE CODE	VIRTUALIZATION AND CONTAINERIZATION	Total Lecture: 45 Practical: 15
CC23B402		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Virtualization and Containerization in the Cloud" is to provide students with a comprehensive understanding of virtualization technologies, including hypervisors, virtual machine management, and orchestration in cloud environments. Additionally, the course aims to introduce students to containerization concepts, such as Docker, and container orchestration using Kubernetes.

UNIT	CONTENTS	HOURS
I.	Virtualization Technologies and Hypervisors:Fundamentals of virtualization Different types of hypervisors, Application of virtualization in creating virtual machines (VMs) for efficient resource utilization in the cloud	10
II.	Virtual Machine Management and Orchestration:Virtual machine lifecycle management, Resource allocation and optimization techniques, Tools and technologies for automating provisioning, scaling, and monitoring of virtual machines in the cloud	10
III.	Introduction to Containerization and Docker:Concept of containerization and its advantages in cloud computing, Introduction to Docker and its ecosystem, Container image creation, lifecycle management, and networking	9
IV.	Container Orchestration with Kubernete:Exploration of Kubernetes as a container orchestration platform, Understanding the architecture, components, and features of Kubernetes, Deployment and management of applications using Kubernetes, including pods, services, deployments, and ingress	8
V.	Microservices Architecture and Deployment in the Cloud:Principles and benefits of microservices architecture in the cloud, Design and deployment of microservices-based applications using containerization and orchestration technologies, Scalable and resilient microservices architectures, service discovery, and inter-service communication	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Describe virtualization and hypervisors in cloud computing, including managing VMs and configuring virtual networks.
CO 2	Manage and orchestrate VMs in the cloud, including provisioning, monitoring, and scaling, with a focus on resource allocation and automation.
CO 3	Gain hands-on experience with Docker and understand the benefits of containerization for cloud application deployment.
CO 4	Proficiently orchestrate containers using Kubernetes, including deployment, scaling, and management, with a focus on service discovery and load balancing.
CO 5	Comprehend microservices architecture and its deployment in the cloud, and develop and deploy microservices-based applications using containerization and orchestration.
Text Books	• Virtualization: Concepts, Methodologies, Tools, and Applications edited by Amarjit Kaur and Harminder Singh. • Kubernetes Cookbook: Building Cloud-Native Applications by Hideto Saito, Hui-Chuan Chloe Lee, and Ke-Jou Carol Hsu
Reference Books	• Docker Cookbook: Over 100 Hands-On Recipes to Build, Ship, and Run Portable Containers by Neependra Khare

COURSE CODE	DEVOPS AND CLOUD AUTOMATION	Total Lecture: 45 Practical: 15
CC23B501		(LTP=3-0-2=4)

Course Objectives:

he objective of the course "DevOps and Cloud Automation" is to provide students with a deep understanding of DevOps culture, practices, and principles, and their application in cloud computing environments. The course aims to equip students with the knowledge and skills to implement continuous integration and continuous delivery (CI/CD) pipelines, manage infrastructure as code (IaC) using configuration management tools, automate cloud orchestration, and optimize performance through effective monitoring and logging in the cloud.

UNIT	CONTENTS	HOURS
I.	DevOps Culture, Practices, and Principles:Fundamental concepts and principles of DevOps, Culture, collaboration, and communication aspects of DevOps, Key practices: version control, continuous integration, continuous delivery, and infrastructure automation	10
II.	Continuous Integration and Continuous Delivery (CI/CD):Concepts and techniques of continuous integration and continuous delivery in cloud environments, Automated build processes, unit testing, and deployment pipelines,Tools and technologies for CI/CD: Jenkins, Git, and artifact repositories	10
III.	Infrastructure as Code (IaC) and Configuration Management:Infrastructure as code and its significance in cloud automation, Configuration management tools: Ansible, Chef, or Puppet, Provisioning and configuring cloud resources using declarative approaches for consistency and repeatability	9
IV.	Cloud Orchestration and Automation Tools:Cloud orchestration and automation tools for managing and scaling cloud resources, Tools like Terraform or AWS CloudFormation for defining infrastructure as code, Automation of provisioning, configuration, and management of cloud resources for efficient application deployment	8
V.	Monitoring, Logging, and Performance Optimization in the Cloud:Importance of monitoring, logging, and performance optimization in cloud environments, Monitoring tools and techniques for application performance and resource utilization tracking, Setting up logging systems for centralized log management,Strategies for optimizing performance and scalability in the cloud	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Apply DevOps culture, practices, and principles in cloud computing to streamline software development, deployment, and operations.
CO 2	Implement and manage CI/CD pipelines for cloud-based applications, incorporating automated testing, version control, and deployment automation.
CO 3	Utilize infrastructure as code (IaC) and configuration management tools to provision and manage cloud resources consistently and efficiently.
CO 4	Automate cloud resource deployment and management using orchestration tools like Ansible, Chef, or Terraform.
CO 5	Monitor, log, and optimize performance in the cloud to identify and resolve issues and improve the scalability and reliability of cloud-based applications.
Text Books	• DevOps Handbook: Practical Guide to Implementing DevOps in Your Organization by Vishal Rao and Rohit Sharma. • Cloud Orchestration with Kubernetes: Container Management, Automation, and Scaling by Hemant Sharma.
Reference Books	• Infrastructure as Code: A Comprehensive Guide to Infrastructure Automation with Terraform by Sairam Venkat.

COURSE CODE	ADVANCED CLOUD SOLUTIONS	Total Lecture: 45 Practical: 15
CC23B502		(LTP=3-0-2=4)

Course Objectives:

: The objective of the course "Advanced Cloud Solutions" is to provide students with an in-depth understanding of advanced cloud computing concepts and technologies. The course aims to equip students with the knowledge and skills to leverage serverless computing, design and deploy microservices architectures, implement hybrid cloud and multi-cloud strategies, develop cloud-native applications, and ensure high availability and scalability in cloud environments.

UNIT	CONTENTS	HOURS
I.	Serverless Computing and Function as a Service (FaaS): Concepts and benefits of serverless computing, Function as a Service (FaaS) offerings: AWS Lambda, Azure Functions, Google Cloud Functions, Designing and deploying serverless applications,Leveraging event-driven architectures and managing serverless resources	10
II.	Microservices Architecture and Deployment Patterns:Principles and advantages of microservices architecture, Deployment patterns and technologies for microservices: Docker, Kubernetes,Designing, developing, and deploying microservices-based applications in the cloud	10
III.	Hybrid Cloud Solutions and Multi-Cloud Strategies:Hybrid cloud solutions and benefits for integrating on-premises infrastructure with public and private cloud environments,Multi-cloud strategies for leveraging multiple cloud providers effectively,Designing and implementing hybrid cloud architectures, Ensuring seamless connectivity and managing data and applications across hybrid and multi-cloud environments	9
IV.	Cloud Native Application Development:Principles and practices of cloud-native application development, Technologies and frameworks for building cloud-native applications: containerization, service mesh, serverless computing, Developing and deploying cloud-native applications using cloud provider services and platforms	8
V.	High Availability and Scalability in the Cloud:Concepts and techniques for achieving high availability and scalability in cloud environments, Fault-tolerant design principles, Load balancing strategies, Auto-scaling techniques, Database scaling options,Architecting and deploying highly available and scalable cloud solutions.	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Understand serverless computing and FaaS concepts and deploy serverless applications using cloud provider services like AWS Lambda, Azure Functions, or Google Cloud Functions.
CO 2	Apply microservices architecture and deployment patterns in cloud environments to design, develop, and deploy microservices-based applications using cloud-native technologies.
CO 3	Implement hybrid cloud solutions and multi-cloud strategies, integrating on-premises infrastructure with public and private cloud environments and effectively leveraging multiple cloud providers.
CO 4	Develop cloud-native applications using containerization technologies like Docker and container orchestration platforms like Kubernetes, leveraging cloud-native services and platforms.
CO 5	Design and implement highly available and scalable cloud architectures using fault tolerance, load balancing, auto-scaling, and infrastructure-as-code approaches in cloud environments.
Text Books	• Serverless Computing with AWS Lambda: A Complete Guide to Building and Deploying Serverless Applications by Abhishek Tiwari • Microservices Architecture: Principles and Patterns for Building Modern Applications" by Rashid Khan.
Reference Books	• Hybrid Cloud Management with IBM Spectrum Scale and IBM Cloud Private" by Vivek Santuka and Prasenjit Sarkar

COURSE CODE	CLOUD BASED DATA SCIENCE AND ANALYTICS	Total Lecture: 45 Practical: 15
CC23B601		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Cloud-Based Data Science and Analytics" is to provide students with a strong foundation in data science and analytics concepts, tools, and techniques in the context of cloud computing. The course aims to equip students with the knowledge and skills to leverage cloud-based data processing and analytics tools, apply machine learning and AI algorithms, utilize big data technologies, create effective data visualizations and reports, and develop cloud-based predictive analytics and decision support systems for data-driven decision making.

UNIT	CONTENTS	HOURS
I.	Machine Learning and AI Fundamentals:Introduction to machine learning and AI concepts, Supervised and unsupervised learning algorithms, Model training and evaluation,Feature selection and engineering, Model deployment in cloud environments	10
II.	Cloud-Based Data Processing and Analytics Tool:Overview of cloud platforms (AWS, Google Cloud, Azure) and their data processing offerings, Data ingestion, storage, transformation, and analysis using services like Amazon S3, Google BigQuery, Azure Data Lake	10
III.	Big Data Technologies in the Cloud: Introduction to big data technologies in the cloud,Frameworks like Apache Hadoop, Spark for distributed data processing and storage in the cloud	9
IV.	Data Visualization and Reporting in Cloud Environments:Techniques and tools for data visualization and reporting in cloud environments, Visualization libraries and platforms like Tableau, Power BI, Matplotlib, Seaborn, Creating interactive visualizations, dashboards, and reports using cloud-based data	8
V.	Cloud-Based Predictive Analytics and Decision Support Systems:Leveraging cloud resources for predictive analytics and decision support systems, Building predictive models using cloud-based machine learning services, Cloud infrastructure for scalable data pipelines, model training, and real-time deployment of predictive models	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Apply ML algorithms for data analysis and predictions in the cloud.
CO 2	Utilize cloud-based data processing and analytics tools and efficiently analyze large datasets using AWS, Google Cloud, or Azure services.
CO 3	Explore big data technologies in the cloud and learn Apache Hadoop, Spark, and similar frameworks for distributed data processing.
CO 4	Excel in data visualization and reporting in the cloud and prepare create interactive visualizations and reports using tools like Tableau, Power BI, or Python's Matplotlib.
CO 5	Develop cloud-based predictive analytics and decision support systems and build ML models and leverage cloud resources to enable data-driven decision making.
Text Books	• Cloud Computing: Theory and Practice" by Dr. Arun Kumar Pujari • Cloud Analytics: Data Science and Machine Learning in the Cloud" by Dr. Siddhartha Bhattacharyya and Dr. Debashis De
Reference Books	• Cloud Computing: A Practical Approach" by Dr. A.S. Rao.

COURSE CODE	FUNDAMENTALS OF INTERNET OF THINGS	Total Lecture: 45 Practical: 15
CC23B602		(LTP=3-0-2=4)

Course Objectives:

The course on Fundamentals of IoT aims to provide students with a comprehensive understanding of the Internet of Things (IoT) technology and its applications. Throughout the course, students will learn about the key concepts, architectures, and components of IoT systems. They will gain knowledge of various IoT protocols and communication technologies used for device connectivity. Additionally, the course will cover data management and analytics techniques specific to IoT, as well as address the critical aspects of security and privacy in IoT deployments

UNIT	CONTENTS	HOURS
I.	Introduction to IoT:Definition and overview of IoT, IoT architectures: edge computing, cloud-centric architectures, hybrid approaches, IoT components: sensors, actuators, gateways, cloud platforms, IoT applications in various sectors, Challenges and considerations in IoT: scalability, interoperability, data privacy, ethics	10
II.	IoT Protocols and Communication:Introduction to IoT protocols: MQTT, CoAP, HTTP, WebSocket 2. Device-to-device communication models, Wireless communication technologies: Wi-Fi, Bluetooth, Zigbee, LoRaWAN,. IoT data synchronization, Interoperability and standardization efforts	10
III.	IoT Data Management and Analytics:Data collection and preprocessing techniques, IoT data storage options: relational databases, NoSQL databases, time-series databases, Real-time analytics for streaming IoT data, Data visualization techniques and tools, Predictive analytics and machine learning in IoT	9
IV.	IoT Security and Privacy:Security challenges in IoT: device vulnerabilities, network security, data privacy, firmware security, Authentication and access control mechanisms, Data encryption and confidentiality techniques, Threat modeling and risk assessment, Privacy considerations and compliance with regulations	8
V.	IoT Applications and Case Studies: IoT applications in smart cities: transportation, waste management, energy management, public safety, IoT applications in healthcare: remote patient monitoring, wearable devices, personalized healthcare, IoT solutions in agriculture: soil monitoring, crop health monitoring, smart irrigation systems, Industrial automation applications: asset tracking, predictive maintenance, supply chain optimization, Analysis of real-world case studies of successful IoT deployments in various industries and domains.	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Discuss the IoT concepts, architectures, and components, including sensors, actuators, gateways, and cloud connectivity.
CO 2	Master various IoT protocols and communication technologies for device connectivity with cloud services.
CO 3	Develop skills in managing and analyzing IoT data, including collection, storage, processing, and applying analytics techniques.
CO 4	Gain awareness of IoT security and privacy challenges, including authentication, encryption, access control, and safeguarding IoT systems and data.
CO 5	Analyze and apply IoT in domains like smart cities, healthcare, agriculture, and industrial automation to identify and develop practical IoT solutions in cloud environments.
Text Books	• "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Sriram Venugopal • "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry"
Reference Books	• "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security" by Perry Lea

COURSE CODE	CLOUD SECURITY AND RISK MANAGEMENT	Total Lecture: 45 Practical: 15
CC23B701		(LTP=3-0-2=4)

Course Objectives:

The course on Cloud Security & Risk Management aims to provide students with a comprehensive understanding of the security challenges and risk management principles in cloud computing environments. The objective is to equip students with the knowledge and skills necessary to effectively secure cloud-based systems and manage risks associated with cloud deployments.

UNIT	CONTENTS	HOURS
I.	Introduction to Cloud Security:Overview of cloud computing, Cloud security fundamentals, Shared responsibility model, Cloud security risks and threats, Cloud security standards and frameworks	10
II.	Cloud Security Controls:Access control mechanism, Encryption and data protection Network security in the cloudCloud application security,Cloud monitoring and logging	10
III.	Cloud Compliance and Risk Management:Compliance requirements, Risk assessment and management, Vendor risk management, Data privacy and protection, Business continuity and disaster recovery	9
IV.	Incident Response and Cloud Security:Incident response framework, Cloud incident response process, Forensics in the cloud,Cloud incident management tools, Incident response planning and exercises	8
V.	Cloud Security Architecture and Design:Secure cloud architecture principles, Cloud infrastructure security, Identity and access management (IAM), Secure multi-tenancy, Cloud security assessment and audit	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Discuss about cloud security principles, including architecture, shared responsibility, and common challenges in cloud computing.
CO 2	Implement and manage security controls in cloud environments, such as access control, encryption, network security, vulnerability management, and monitoring.
CO 3	Assess and manage risks in cloud deployments, including identification, analysis, and implementation of risk mitigation strategies.
CO 4	Explain the compliance requirements and regulatory frameworks in cloud computing, ensuring adherence to data protection regulations and industry-specific standards.
CO 5	Develop incident response and disaster recovery skills for cloud-based systems, including effective incident handling, containment, remediation, and robust disaster recovery planning.
Text Books	• "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" • "Cloud Computing Security: Foundations and Challenges" by John R. Vacca:
Reference Books	• "Cloud Security and Governance: Who's on Your Cloud?" by Sohal Goyal, Madhulika Goyal, and Bhavani Thuraisingham

COURSE CODE	CLOUD SECURITY AND NETWORKING	Total Lecture: 45 Practical: 15
CC23B702		(LTP=3-0-2=4)

Course Objectives:

The objective of the course "Cloud Security and Networking in the Cloud" is to provide students with a comprehensive understanding of cloud security principles, best practices, and technologies. The course aims to equip students with the knowledge and skills to design and implement secure cloud architectures, manage identity and access in the cloud, implement network security measures, monitor and respond to security incidents, and ensure compliance and governance in cloud computing environments

UNIT	CONTENTS	HOURS
I.	Cloud Security Principles and Best Practices:Confidentiality, integrity, and availability, Secure access management, Data encryption,Threat detection,Security controls and frameworks	10
II.	Identity and Access Management (IAM) in the Cloud: IAM concepts, User authentication and authorization, Identity federation, IAM services provided by cloud providers, User account, role, and permission management	10
III.	Network Security in Cloud Environments:Securing network connections, Virtual private networks (VPNs), Firewalls, Network segmentation, Security groups and network ACLs, Intrusion detection and prevention systems (IDPS)	9
IV.	Security Monitoring and Incident Response in the Cloud:Log analysis, Intrusion detection systems (IDS),Security information and event management (SIEM) tools, Security incident detection and response, Forensic investigations, Incident response plans	8
V.	Compliance and Governance in Cloud Computing:Industry regulations and data privacy laws, Compliance frameworks, Auditing,Risk management, Compliance controls, Legal and regulatory requirements in the cloud	8

List of Experiments:

Course Outcome as per Bloom's Taxonomy

At the end of the course the students will be able to**:**

CO 1	Demonstrate understanding of cloud security principles, encryption techniques, and security controls for secure cloud architectures.
CO 2	Acquire expertise in IAM, including user authentication, authorization, and RBAC for secure access to cloud resources.
CO 3	Develop skills in deploying VPNs, firewalls, and IDPS for secure network design and segmentation in cloud environments.
CO 4	Gain proficiency in security monitoring, incident detection and response, log analysis, and forensic investigations in the cloud.
CO 5	Discuss about the compliance, privacy laws, data protection, and risk management frameworks to ensure adherence to legal and regulatory requirements in cloud computing.
Text Books	• Cloud Security and Governance: A Comprehensive Guide to Secure Cloud Environments by Prashant Priyam and Ritwik Priyam.
Reference Books	• Securing the Cloud: Cloud Security Architecture, Controls, and Countermeasures by V. K. Chaubey and Praveen D. Satya • Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance by Sudhir Kumar and Vijay Raghavan