SHRI GURU RAM RAI UNIVERSITY

Patel Nagar, Dehradun-248001, Uttarakhand, India
[Estd. by Govt. of Uttarakhand, vide Shri Guru Ram Rai University Act no. 03 of 2017 & recognized by UGC u/s (2f) of UGC Act 1956]

Minutes of Meeting of Seventh Board of Studies Meeting held at Department of Computer Application, School of Engineering & Technology on 19-07-2025

Ref. No. SGRRU/SET/2025/061
Date of Meeting: 19th July, 2025 Time: 11:00 AM

Meeting Presided by: Prof. (Dr.) Sonika Kandari, Dean, School of Engineering & Technology
Minutes of Meeting Prepared by: Dr. GD Makkar, HOD, Department of CA, School of Engineering & Technology

The seventh Board of Studies Meeting for Department of Computer Application, School of Engineering & Technology was called by Dr. Sonika Kandari, Chairman of BoS, Dean, School of Engineering & Technology, SGRR University, Dehradun on 19th July, 2025 to discuss upon the following agenda:

Agenda Items of the Meeting:

1. Confirmation of minutes of 6th Board of Studies (BoS) Meeting.
2. Curriculum enhancement in accordance of NEP 2020 scheme into Discipline Core, Discipline Elective, Generic Electives, Skill Enhancement, Ability Enhancement and Value-Addition Courses for the Program BCA.
3. Curriculum Enhancement in the MCA program.
4. Discussion on MOOCs course to be incorporated in MCA and BCA programs to provide flexibility in Curriculum.
5. To Discuss Exit Policy Framework for BCA
6. To discuss the Program Structure of BCA 3 year/4-year Honours/Honours with Research Program.
7. To discuss the Program Structure of MCA.
8. Discussion on Implementation of One Full Semester (VIth Semester) for Project in BCA, Research Project in VIIIth Semester of BCA (Honors with Research) and Project/Research Project in IVth Semester of MCA
9. To discuss on Program Outcomes (POs), Course Outcomes (COs) & their Mapping in MCA and BCA programs.
10. To discuss the Examination and Evaluation Scheme.
11. Any other item with the permission of Chair.

The following BoS Panel Members were present in the meeting:

BoS Panel

1. Prof. (Dr.) Sonika Kandari, Dean, SET Chairman BoS
2. Prof (Dr.) MMS Rauthan, Professor, HNB Garhwal University, External Expert
3. Dr. Ashish Negi, Professor, GB Pant Engineering College, Pauri Garhwal, External Expert
4. Mrs. Shalu Pundir, Senior Software Developer, TCS, Industry Expert.
5. Prof. (Dr.) Harsh Kumar, Head, Professor, Member
6. Mr. Vaibhav Sharma, Associate Professor, Member
7. Mr. Harish Sharma, Associate Professor, Member
8. Ms. Minit Arora, Associate Professor, Member
9. Dr. Shalini Rawat, Assistant Professor, Member
10. Dr. Akanksha Devrari, Assistant Professor, Member
11. Mr. Abhishek Singh, Alumni Representative
12. Ms. Supriya Raturi, PhD Research Scholar, student representative
13. Mr. Aman Singh Rawat, PhD Research Scholar, student representative
14. Ms. Kashish Garg, BTech III Semester, student representative
15. Suresh Pokhrail; MCA III Semester student representative
16. Ms. Vaishali Singhal, MCA I Semester, Student Representative
17. Dr. GD Makkar, Head, Department of Computer Application, Member Secretary, BoS

Agendas Discussed:

Dr. Sonika Kandari, Chairman of the Board of Studies (BoS), warmly welcomed all members to the Seventh BoS Meeting of the Department of Computer Applications. She expressed sincere gratitude to the External Experts for graciously taking time from their busy schedules to attend the meeting.

The Head of the Department of Computer Applications, School of Engineering & Technology, SGRR University, introduced the members and presented a brief overview of the proposed curriculum for the MCA and BCA programs.

A summary of the School's and Department's profile and recent progress was also shared during the session.

With the kind permission of the chair, the following agendas were discussed:

Agenda 1: Confirmation of Minutes of 6th Board of Studies (BoS) Meeting

Resolution:
The HoD, Computer Applications, provided an update to the Board Members on the proceedings of the previous meeting (6th BoS) held on 3rd July, 2023, which were unanimously accepted as proposed.

Agenda 2: Curriculum Enhancement in accordance of NEP 2020 scheme into Discipline Core, Discipline Elective, Generic Electives, Skill Enhancement, Ability Enhancement and Value-Addition Courses for the Program BCA.

Resolution:
The HoD, Computer Applications, informed the Committee Members that the BCA program has been revised to incorporate new courses into the existing curriculum. These additions include Discipline Specific Core (DSC), Discipline Specific Elective (DSE), Generic Electives (GE), Skill Enhancement Courses (SEC), and Value-Addition Courses (VAC). All courses have been structured in alignment with the guidelines of the National Education Policy (NEP) 2020.

The newly proposed courses for the program have been assigned specific course codes and credits, as detailed below:

S. No.	Category of Course	Course Code	Course Name	Semester	Credits
1	Skill enhancement	BCASC301	Big Data Analytics	3rd	2
2	Value Addition course	CITVC301	Introduction to Data Science	3rd	2
3	Discipline Specific Core	BCADSC503	Introduction to Machine Learning	5th	4
4	Generic Elective	BCAGE501	Enterprise Resource Planning	4th	4
5	Project	BCAPR6	Project	6th	12
6	Discipline Specific Core	BCADSC801	Machine Learning using Python	8th	3
7	Discipline Specific Core	BCAP81	Machine Learning Lab	8th	1
8	Discipline Specific Elective	BCADSE802A	Introduction to Deep Learning/ MOOC	8th	4
9	Research Project	BCARP8	Dissertation on Research Project - II	8th	18

Abhishek Kashish Sadiyan Vaishali

A student has the option to choose a Generic Elective (GE) course from the elective basket offered by the University, which may include courses from within the School or from other Schools of the University.

Ability Enhancement Courses (AEC) are to be taken during the first four semesters of the BCA program. These courses have been identified as relevant and beneficial in enhancing students' subject knowledge and professional competencies.

The suggestions regarding these courses were accepted with minor corrections as proposed.

Agenda 3: Curriculum Enhancement in the MCA program.

Resolution:
The HoD, Computer Applications, informed the Committee Members that the MCA program has been updated to incorporate new courses into the existing curriculum. These newly proposed courses have been carefully designed to meet current industry and academic requirements. The proposed new courses have been assigned specific course codes and credits, which are listed as follows:

S. No.	Category of Course	Course Code	Course Name	Semester	Credits
1	Bridge Course	BRD101	Basic Mathematics	1st	3
2	Bridge Course	BRD103	Fundamental of Information Technology	1st	3
3	Core	MCA101	Computer Organization & Architecture	1st	3
4	Core	MCA103	Mathematics for Data Science	1st	3
5	Core	MCA107	Human Values and Ethics	1st	2
6	Elective	MCA304.1	Machine Learning	3	3
7	Elective	MCAP34.1	Machine Learning Lab	3	1
8	Elective	MCA304.2	Full Stack Web Development	3	3
9	Elective	MCAP34.2	Full Stack Web Development Lab	3	1
10	Elective	MCA305.1	Introduction to Deep Learning	3	3

11	Elective	MCA306.2	Software Project Management	3	3
12	Elective	MCA 303	Theory of Automata	3	3

Agenda 4: Discussion on MOOCs course to be incorporated in MCA and BCA programs to provide flexibility in Curriculum.

Resolution:
As per the discussion, MOOC courses are introduced as substitutes for Discipline Specific Elective (DSE) courses, allowing BCA students the flexibility to choose a MOOC course on the same subject or closely related subject in place of a DSE course offered during the Vth to VIIIth semesters of the program.

If a student fails to submit the Course Completion Certificate for the selected MOOC course, he/she will be permitted to appear for the University's End Semester Examination of the corresponding Discipline Specific Elective course.

A student is allowed to opt for only one MOOC course per semester (where applicable) in the BCA program. Regardless of MOOC registration status, all students will be permitted to appear in the University End Semester Examination for the concerned DSE course.

In the MCA program, MOOC has been introduced in the IVth semester, wherein students may choose a MOOC course on any latest technological topic not already included in the existing curriculum.

Experts recommended that MOOC courses selected by students must be pre-approved by the Department. The course duration must be 12 weeks for a 4-credit course and 8 weeks for a 3-credit course. Students are required to submit the Course Completion Certificate or Score Card to the Department.

Students can enroll in MOOC courses through the SWAYAM portal or any other Government platform.

Agenda 5: Exit Policy Framework for BCA program.

Resolution:
The HoD, Computer Applications, explained the existing Exit Policy Framework in detail, outlining the provisions and options available to students at various stages of the BCA progam. The framework includes guidelines on academic progression, credit requirements, and eligibility criteria for exit with appropriate certification as per NEP 2020 guidelines.

After a thorough discussion, the Committee approved the Exit Policy Framework as proposed.

S.No.	Name of Program	Duration of the program	Remarks
1	**Certificate in Computer Application** after completing 1 year (2 semesters) of study	1 Year	Students who opt to exit after completion of the first year and have secured **44 credits** will be awarded a UG certificate if, in addition, they complete one vocational course/Internship of **4 credits** during the summer vacation of the first year. These students are allowed to re-enter the degree program within three years and complete the degree program within the stipulated maximum period of seven years
2	**Diploma in Computer Application** after 2 years (4 semesters) of study	2 Years	Students who opt to exit after completion of the second year and have secured **88 credits** will be awarded the UG diploma if, in addition, they complete one vocational course/Internship of **4 credits** during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree program within the maximum period of seven years.
3	**Bachelor in Computer Application** after 3-year (6 semesters) program of study	3 Years	Students who wish to undergo a 3-year UG program will be awarded UG Degree, Bachelor in Computer Application in the Major discipline after successful completion of three years, securing **122 credits**.
4	**Bachelor in in Computer Application (Honours) OR Bachelor in in Computer Application (Honours with Research)** after 4 years (8 semester) program of study	4 Years	A four-year UG Honours degree **(Bachelor in Computer Application (Honours) OR (Bachelor in Computer Application (Honours with Research)** in the major discipline will be awarded to those who complete a four-year degree program with **162 credits**.

Agenda 6: To discuss the Program Structure of BCA 3 year/4 year Honours/Honours with Research Program.

Resolution:
The HoD, Computer Applications informed the Committee Members about the regular BCA (3-year undergraduate program) and BCA (Honours) / BCA (Honours with Research) programs with a 4-year duration.

The following suggestions from external experts have been incorporated into the curriculum:

1. The course *Data Structure and File Organization* has been renamed to *Data Structure* in the 2nd semester (Course Code: BCADSC201).
2. The course *Advanced Java* has been replaced with *C# .NET* in the 5th semester (Course Code: BCADSC502).
3. Guidelines for *Academic Project* and *Research Project* have been finalized as per the details mentioned in the curriculum.

All members agreed on Program Structure as proposed. (Attached as annexure-I)

Agenda 7: To discuss the Program Structure of MCA.

Resolution:
The HoD of Computer Applications informed the Committee Members about the MCA program and the suggestions that were incorporated into the curriculum based on recommendations from external experts:

1. The course *Computer Organization & Architecture (MCA101)* has been added to the 1st semester.
2. The *Artificial Intelligence* course has been shifted to the 3rd semester, and a new course *Cyber Security (MCA105)* has been included in its place in the 1st semester.
3. The course title *Statistics* has been renamed to *Mathematics for Data Science (MCA103)*.
4. A new course *Human Values & Ethics (MCA107)* has been introduced in the 1st semester.
5. The course *Theory of Automata* will now be offered as an elective rather than a core subject.
6. The course *Programming in C* will be included as part of the bridge course instead of the regular MCA curriculum.
7. The course *Fundamentals of Information Technology* will also be part of the bridge course.

All members agreed on Program Structure as proposed. (Attached as annexure-II)

Agenda 8: Discussion on Implementation of One Full Semester (VIth Semester) for Project in BCA, Research Project in VIIIth Semester of BCA (Honors with Research) and Project/Research Project in IVth Semester of MCA.

Resolution:
The Committee unanimously approved the introduction of a Full One Semester Project as part of the curriculum in the VIth semester of the BCA program, a Research Project in the VIIIth semester of the BCA (Honours with Research) program, and a Project/Research Project in the IVth semester of the MCA program.

These projects may be undertaken either within the University or in collaboration with an industry partner. The inclusion of this component aims to provide students with practical exposure to real-world work environments, thereby bridging the gap between academic learning and industry practices. It will allow students to apply their theoretical knowledge to real-life projects, enhancing their understanding of the software development lifecycle.

The Research Project component is designed to strengthen students' research aptitude, fostering critical thinking and encouraging exploration of emerging research trends within their respective domains.

Agenda 9: To discuss on Program Outcomes (POs), Course Outcomes (COs) & their Mappings in MCA and BCA Programs

Resolutions:
All members of the Committee agreed on the need to redefine the Program Outcomes (POs) and Course Outcomes (COs) for the courses discussed. For each course, the relevant and appropriate COs have been revised in accordance with the suggestions provided by the Board Members. These modifications ensure that the Course Outcomes align effectively with the overall objectives and intended learning outcomes of the MCA and BCA programs, thereby enhancing the academic rigor and relevance of the curriculum.

Agenda 10: To discuss the Examination and Evaluation Scheme.

Resolution:
All members unanimously agreed that the medium of instruction and examination for the MCA and BCA programs will be English. The Committee also agreed to adhere to the question paper pattern, examination duration, and the distribution of internal and external marks (End Semester Examination – ESE) in accordance with the norms and guidelines established by SGRR University, as outlined in the University Examination Ordinance.

Agenda 11: Any other item with the permission of Chair.

Resolution:
With no further points left for discussion, the Chairman concluded the meeting by extending a vote of thanks to all members for their valuable contributions and active participation.

Signatures of Members Present:

SNo	Name of Member	Internal/Expert	Designation	Signature
1	Prof. (Dr.) Sonika Kandari	Internal Member	Professor & Chairman	
2	Prof (Dr.) MMS Rauthan	External Expert (Academic)	Professor, H.N.B Grahwal University	
3	Prof (Dr.) Ashish Negi	External Expert (Academic)	Professor, GB Pant Engineering College	
4	Mrs. Shalu Pundir	Externa Expert (Industry)	TCS Senior Software Developer	
5	Prof. (Dr.) Harsh Kumar	Internal Member	Professor	
6	Mr. Vaibhav Sharma	Internal Member	Associate Professor	
7	Mr. Harish Sharma	Internal Member	Associate Professor	
8	Ms. Minit Arora	Internal Member	Associate Professor	
9	Dr. Shalini Rawat	Internal Member	Assistant Professor	
10	Dr. Akanksha Devrani	Internal Member	Assistant Professor	
11	Mr. Abhishek Singh	Alumni	Software Engineer, EFT Corporation	
12	Ms Supriya Raturi	Internal Member	PhD Research Scholar	
13	Mr Aman Singh Rawat	Internal Member	PhD Research Scholar	
14	Ms Kashish Garg	Internal Member	BTech III 'Semester, student representative	
15	Suresh Pokhrail	Internal Member	MCA III Semester student representative	
16	Ms Vaishali Singhal	Internal Member	MCA I Semester, Student Representative	

17	Dr. G.D. Makkar	Internal Member	Head, Department of Computer Application, Member Secretary, BoS	

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CURRICULUM & SYLLABI FOR

Certificate in Computer Applications – 1 Year

Diploma in Computer Applications – 2 Years

Bachelor in Computer Applications – 3 Years

Bachelor in Computer Applications (Honours) – 4 Years

Bachelor in Computer Applications (Honours with Research) – 4 Years

As per NEP 2020

School of Engineering & Technology

(w.e.f. 2025-2026)

Ordinance of Bachelor in Computer Application

Bachelor of Computer Application is an undergraduate degree programmes of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

S.No.	Name of Program	Duration of the program	Remarks
1	**Certificate in Computer Application** after completing 1 year (2 semesters) of study	1 Year	Students who opt to exit after completion of the first year and have secured **44 credits** will be awarded a UG certificate if, in addition, they complete one vocational course/Internship of **4 credits** during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years
2	**Diploma in Computer Application** after 2 years (4 semesters) of study	2 Years	Students who opt to exit after completion of the second year and have secured **88 credits** will be awarded the UG diploma if, in addition, they complete one vocational course/Internship of **4 credits** during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
3	**Bachelor in Computer Application** after 3-year (6 semesters) programme of study	3 Years	Students who wish to undergo a 3-year UG programme will be awarded UG Degree, Bachelor in Computer Application in the Major discipline after successful completion of three years, securing **122 credits**.
4	**Bachelor in Computer Application (Honours)** **OR** **Bachelor in Computer Application (Honours with Research)** after 4 years (8 semester) programme of study	4 Years	A four-year UG Honours degree **Bachelor in Computer Application (Honours) OR Bachelor in Computer Application (Honours with Research)** in the major discipline will be awarded to those who complete a four-year degree programme with **162 credits**.

Eligibility for admission:

Intermediate (Class XII) in any discipline with minimum 45% marks and Maths as compulsory subject at 10+2.

Duration of the Programme: 3/4 years

Examination Scheme:

	Internal Assessment		External Assessment (ESE)
Components	**Internal Exam**	**Assignment & Teacher Assessment**	
Weightage (%)	**15**	**15**	**70**

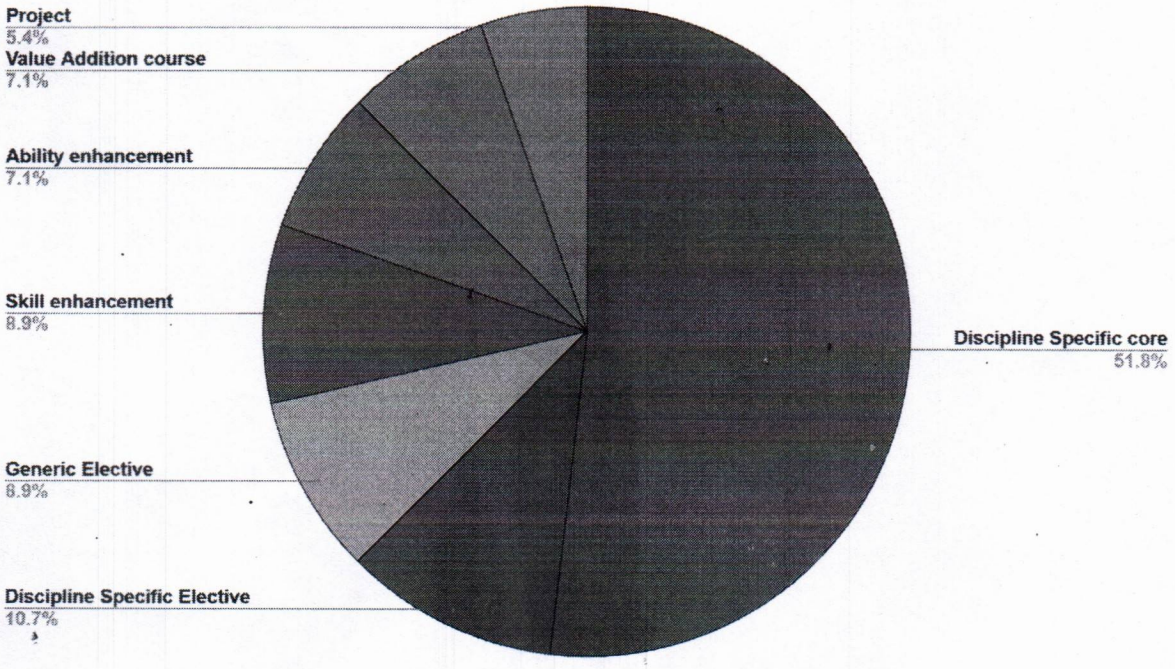
Programme outcome (POs)

Students will be able to

PO1	Ability to demonstrate knowledge of Computer science and its applications in order to enhancebasic understanding of various software technologies.
PO2	Ability to analyze and identify various business and technical problems to further solve problemswith effective communication.
PO3	Ability to adapt analytical, logical and managerial skills with the technical aspects in order to design and deploy reliable software programs and application for real world problems
PO4	Ability to investigate complex problems and provide computer-based solutions.
PO5	Ability to understand and deliver ethical, social and cultural responsibilities in professional environment as an individual and team.
PO6	Ability to adapt new technologies for upgrading their skills and contributing to a life long learning.
PO7	Ability to create and manage multidisciplinary projects and successfully apply software and project management principles.
PO8	Ability to become employable in a variety of IT companies and government sector and also seek entrepreneurship opportunities for the betterment of an individual and society at large.
PO9	An ability to design and implement database solutions using available technologies.
PO10	Acquired skills and to recognize the need for life-long learning for continuing professional development.
PO11	Excellent verbal communication skills with capability to work in multidisciplinary teams with positive attitude
PO12	An ability to work effectively as an individual as well as a member of a team and provide technical and visionary leadership to others.

Course Structure and Credit Distribution

Discipline Specific core	Discipline Specific Elective	Generic Elective	Skill enhancement	Ability enhancement	Value Addition course	Project
29	6	5	5	4	4	3



Semester wise Course Structure and Credit Distribution

	Discipline Specific	Discipline Specific	Generic Elective	Skill Enhancement	Ability Enhancement	Value Addition	Project	Total
Semester I	12		4	2	2	2		**22**
Semester II	12		4	2	2	2		**22**
Semester III	12		4	2	2	2		**22**
Semester IV	12		4	2	2	2		**22**
Semester V	12	4	4	2				**22**
Semester V I							12	**12**
Semester VII	4	12					6	**22**
Semester VIII (Honours)	4	8					6	**18**
OR								
Semester VIII (Research Honours)							18	18
	68/64	**24/16**	**20**	**10**	**8**	**8**	**24/36**	
							Total Credit	**162**

Category-wise Distribution

	Discipline core	Discipline Specific Elective	Generic Elective	Skill enhancement	Ability enhancement	Value Addition course	Project
BCA	60	4	20	10	8	8	12
BCA (Honours)	68	24	20	10	8	8	24
BCA (Honours with Research)	64	16	20	10	8	8	36

3 Year BCA Program	**Total Credit: 122**
4 Year BCA (Honours) and BCA (Honours with Research)	**Total Credit: 162**

General Course Structure and Theme:

Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Lecture (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

Course Code and Definition:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
DSC	Discipline Specific Course
DSE	Discipline Specific Elective
GE	Generic Elective
SC	Skill Enhancement
AEC	Ability Enhancement
VAC	Value Addition course
SM	Seminar
PR	Project
RP	Research project

CATEGORY WISE COURSES

Discipline Specific core

Couse Code	Course Name	Credits
BCADSC101	Programming in 'C'	3
BCAP11	Programming in 'C' Lab	1
BCADSC102	Computer Fundamental & Information Technology	3
BCAP12	Computer Fundamental Lab	1
BCADSC103	Mathematical Foundation of Computer Science	4
BCADSC201	Data Structure	3
BCAP21	Data Structure Lab	1
BCADSC202	Java Programming	3
BCAP22	Java Lab	1
BCADSC203	Digital Electronics	4
BCADSC301	Android Programming	3
BCAP31	Android Programming Lab	1
BCADSC302	Web Programming	3
BCAP32	Web Programming Lab	1
BCADSC303	Computer Networks	4
BCADSC401	Database Management System	3
BCAP41	Database Management Systems Lab	1
BCADSC402	Operating System	3
BCAP42	UNIX Lab	1
BCADSC403	Software Engineering	4
BCADSC501	Python Programming	3
BCAP51	Python Programming Lab	1
BCADSC502	C# Dot Net	3
BCAP52	C# Dot Net Lab	1
BCADSC503	Introduction to Machine Learning	4
BCADSC701	Data Science using Python	3
BCAP71	Data Science Lab	1
BCADSC801	Machine Learning using Python	3
BCAP81	Machine Learning Lab	1
	Total Credits	**68**

Discipline Specific Elective

Couse Code	Course Name	Credits
BCADSE504A BCADSE504B	Statistics/ MOOC on Statistics Operations Research/ MOOC on Operations Research	4
BCADSE702A BCADSE702B	Research Methodology and Publication Ethics Software Project Management	4
BCADSE703A BCADSE703B	Introduction To IOT / MOOC on IOT Advance RDBMS/ MOOC on Advance RDBMS	4
BCADSE704A BCADSE704B	Introduction To Blockchain / MOOC on Blockchain Network Security & Cryptography/ MOOC on Network Security & Cryptography	4
BCADSE802A BCADSE802B	Introduction to Deep Learning/ MOOC on Deep Learning Cloud Computing/ MOOC on Cloud Computing	4
BCADSE803A BCADSE803B	Algorithm Analysis & Design/ MOOC on Algorithm Analysis & Design Computer Graphics/ MOOC Computer Graphics	4
	Total	**24**

Generic Elective Courses

Couse Code	Course Name	Credits
BCAGE101	Office Automation	4
BCAGE201	Cyber Security	4
BCAGE301	System Analysis & Design	4
BCAGE401	Artificial Intelligence	4
BCAGE501	Enterprise Resource Planning	4
	Total	**20**

Skill Enhancement Courses

Couse Code	Course Name	Credits
BCASC101	Personality Development and Soft Skills	2
BCASC201	Leadership Skills	2
BCASC301	Big Data Analytics	2
BCASC401	Digital Marketing	2
BCASM5	Seminar	2
	Total	**10**

Ability enhancement Courses

Couse Code	Course Name	Credits
AEC1	Environmental Studies – I	2
AEC2	Communication Skills: Listening and Speaking Skills	2
AEC3	Environmental Studies - II	2
AEC4	Communication Skills: Reading and Writing Skills	2
	Total	**8**

Value Addition Courses

Couse Code	Course Name	Credits
CITVC101	Computer and Ethics	2
CITVC201	The Art of Clean Code	2
CITVC301	Introduction to Data Science	2
CITVC401	Challenges in Programming	2
	Total	**8**

Project

Couse Code	Course Name	Credits
BCAPR6	Project	12
BCAPR7	Dissertation on Research/Academic Project - I	6
BCAPR8 **OR** BCARP8	Dissertation on Academic Project – II **OR** Dissertation on Research - II	6 18
	Total	**24/36**

Basic Structure of CCA, DCA, BCA (Honours) and BCA (Honours in Research)

STUDY & EVALUATION SCHEME
Choice Based Credit System

Certificate in Computer Application (CCA)

1st Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC101	Programming in 'C'	3	-	-	3	30	70	100
2	Discipline Specific core	BCADSC102	Computer Fundamental & Information Technology	3	-	-	3	30	70	100
3	Discipline Specific core	BCADSC103	Mathematical Foundation of Computer Science	4	-	-	4	30	70	100
4	Generic Elective	BCAGE101	Office Automation	4	-	-	4	30	70	100
5	Skill enhancement	BCASC101	Personality Development and Soft Skills	2	-	-	2	30	70	100
6	Ability enhancement	AEC1	Environmental Studies – I	2	-	-	2	30	70	100
7	Value Addition course	CITVC101	Computer and Ethics	2	-	-	2	30	70	100
Practical										
8	Major/Core	BCAP11	Programming in 'C' Lab	-	-	2	1	30	70	100
9	Major/Core	BCAP12	Computer Fundamental Lab	-	-	2	1	30	70	100
			Total	**20**	**-**	**4**	**22**	**270**	**630**	**900**

2nd Semester

S. No	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (INT)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC201	Data Structure	3	-	-	3	30	70	100
2	Discipline Specific core	BCADSC202	Java Programming	3	-	-	3	30	70	100
3	Discipline Specific core	BCADSC203	Digital Electronics	3	1	-	4	30	70	100
4	Generic Elective	BCAGE201	Cyber Security	4	-	-	4	30	70	100
5	Skill enhancement	BCASC201	Leadership Skills	2	-		2	30	70	100
6	Ability enhancement	AEC2	Communication Skills: Listening and Speaking Skills	2	-	-	2	30	70	100
7	Value Addition course	CITVC201	The Art of Clean Code	2	-	-	2	30	70	100
Practical										
8	Core	BCAP21	Data Structure Lab	-	-	2	1	30	70	100
9	Core	BCAP22	Core Java Lab	-	-	2	1	30	70	100
			Total	**19**	**1**	**4**	**22**	**270**	**630**	**900**
Exit option with **Certificate in Computer Applications** (with the completion of courses equivalent to a minimum of **44 credits**) + **4** Exit Credits				**Total Credits (I[st] & II[nd] Sem)**			**44**	**Total Marks (I[st] & II[nd] Sem)**		**1800**

Diploma in Computer Application (DCA)

[CCA & 2nd year]

3rd Semester

S. No	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC301	Android Programming	3	-	-	3	30	70	100
2	Discipline Specific core	BCADSC302	Web Programming	3	-	-	3	30	70	100
3	Discipline Specific core	BCADSC303	Computer Networks	3	1	-	4	30	70	100
4	Generic Elective	BCAGE301	System Analysis & Design	3	1	-	4	30	70	100
5	Skill enhancement	BCASC301	Big Data Analytics	2	-	-	2	30	70	100
6	Ability enhancement	AEC3	Environmental Studies - II	2	-	-	2	30	70	100
7	Value Addition course	CITVC301	Introduction to Data Science	2	-	-	2	30	70	100
Practical										
8	Major/ Core	BCAP31	Android Programming Lab	-	-	2	1	30	70	100
9	Major/ Core	BCAP32	Web Programming Lab	-	-	2	1	30	70	100
			Total	**18**	**2**	**4**	**22**	**270**	**630**	**900**

4th Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC401	Database Management System	3	-	-	3	30	70	100
2	Discipline Specific core	BCADSC402	Operating System	3	-	-	3	30	70	100
3	Discipline Specific core	BCADSC403	Software Engineering	3	1	-	4	30	70	100
4	Generic Elective	BCAGE401	Artificial Intelligence	4	-	-	4	30	70	100
5	Skill enhancement	BCASC401	Digital Marketing	2	-	-	2	30	70	100
6	Ability enhancement	AEC4	Communication Skills: Reading and Writing Skills	2	-	-	2	30	70	100
7	Value Addition course	CITVC401	Challenges in Programming	2	-	-	2	30	70	100
Practical										
8	Major/Core	BCAP41	Database Management Systems Lab	-	-	2	1	30	70	100
9	Major/Core	BCAP42	UNIX Lab	-	-	2	1	30	70	100
			Total	**19**	**1**	**4**	**22**	**270**	**630**	**900**
Exit option with **Diploma in Computer Applications** (with the completion of courses equivalent to a minimum of 88 credits) + 4 Exit Credits				**Total Credits (I st to IV th Sem)**			**88**	**Total Marks (I st to IV th Sem)**		**3600**

Bachelor in Computer Application (BCA)

[DCA & 3rd year]

5th Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC501	Python Programming	3	-	-	3	30	70	100
2	Discipline Specific core	BCADSC502	C# Dot Net	3	-	-	3	30	70	100
3	Discipline Specific core	BCADSC503	Introduction to Machine Learning	3	1	-	4	30	70	100
4	Discipline Specific Elective	BCADSE504A	Statistics/ MOOC	4	0	-	4	30	70	100
		BCADSE504B	Operations Research/ MOOC							
5	Generic Elective	BCAGE501	Enterprise Resource Planning	4	0	-	4	30	70	100
Practical										
6	Major/Core	BCAP51	Python Programming Lab	-	-	2	1	30	70	100
7	Major/Core	BCAP52	C# Dot Net Lab	-	-	2	1	30	70	100
8	Skill Enhancement	BCASM5	Seminar	-	-	4	2	100	-	100
			Total	**17**	**1**	**8**	**22**	**310**	**490**	**800**

- Students may enroll in a 12-week MOOC course (equivalent to 4 credits) on the specified subject with MOOC, available through the SWAYAM portal or any other Government platform.
- If the same subject is not available, the student may choose a similar subject as an alternative.
- Prior approval must be obtained from the department before enrolling.
- Upon completion, students must submit the course certificate and marksheet to the department for the credit to be transferred to their BCA program.

6th Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
1	Project	BCAPR6	Project	-	-	24	12	150	350	500
			Total			**24**	**12**	**150**	**350**	**500**
Exit Option with Bachelor of Computer Applications Degree, BCA Degree (with completion of courses equivalent to a minimum of 132 credits)				**Total Credits (Ist to VIth Sem)**			**122**	**Total Marks (Ist to VIth Sem)**		**4900**

The Project is a semester-long, comprehensive experimental or research-based assignment undertaken during the final semester of study. It is designed to provide students with a culminating academic and intellectual experience and carries a weightage of 12 credits. The project is to be completed in groups of no more than three students and can be pursued through any one of the following three modes:

- **Mode 1:** The project may be undertaken within the department under the supervision of a faculty member.
- **Mode 2:** The project may be conducted as part of an industry internship, arranged either through the University's Career and Placement Services or independently by the student, provided it is with a reputed organization and has received prior approval from the department.
- **Mode 3:** The project may be pursued in a nationally or internationally recognized academic institute, research laboratory, or industry, subject to prior approval from the department.

Bachelor in Computer Application (Honors/ Honors in Research)
[BCA & 4th year]

7th Semester

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC701	Data Science using Python	3	-	-	3	30	70	100
2	Discipline Specific Elective	BCADSE702A	Research Methodology and Publication Ethics	3	1	-	4	30	70	100
		BCADSE702B	Software Project Management							
3	Discipline Specific Elective	BCADSE703A	Introduction To IOT / MOOC	4	-	-	4	30	70	100
		BCADSE703B	Advance RDBMS/ MOOC							
4	Discipline Specific Elective	BCADSE704A	Introduction To Blockchain / MOOC	4	-	-	4	30	70	100
		BCADSE704B	Network Security & Cryptography/ MOOC							
Practical										
5	Major/Core	BCAP71	Data Science Lab	-	-	2	1	30	70	100
6	Project	BCAPR7	Dissertation on Research/Academic Project - I	-	-	12	6	30	70	100
			Total	**14**	**1**	**14**	**22**	**180**	**420**	**600**

- Students may enroll in a 12-week MOOC course (equivalent to 4 credits) on the specified elective subject with MOOC, available through the SWAYAM portal or any other Government platform.
- If the same subject is not available, the student may choose a similar subject as an alternative.
- Prior approval must be obtained from the department before enrolling.
- Upon completion, students must submit the course certificate and marksheet to the department for the credit to be transferred to their BCA program.
- Marksheet will reflect the Course Title of MOOC course done by student.

8th Semester (BCA Honours)

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
Theory										
1	Discipline Specific core	BCADSC801	Machine Learning using Python	3	-	-	3	30	70	100
3	Discipline Specific Elective	BCADSE802A	Introduction to Deep Learning/ MOOC	4	-	-	4	30	70	100
		BCADSE802B	Cloud Computing/ MOOC							
4	Discipline Specific Elective	BCADSE803A	Algorithm Analysis & Design/ MOOC	4	-	-	4	30	70	100
		BCADSE803B	Computer Graphics/ MOOC							
Practical										
5	Major/Core	BCAP81	Machine Learning Lab	-	-	2	1	30	70	100
6	Project	BCAPR8	Dissertation on Academic Project - II	-	-	12	6	30	70	100
			Total	**11**	**0**	**14**	**18**	**150**	**350**	**500**
Exit Option with **Bachelor of Computer Applications (Honors with Research/ Academic Project/ Entrepreneurship)** with completion of courses equivalent to a minimum of 176 credits.				**Total Credits (Ist to VIIIth Sem)**			**162**	**Total Marks (Ist to VIIIth Sem)**		**6000**

- Students may enroll in a 12-week MOOC course (equivalent to 4 credits) on the specified subject with MOOC, available through the SWAYAM portal or any other Government platform.
- If the same subject is not available, the student may choose a similar subject as an alternative.
- Prior approval must be obtained from the department before enrolling.
- Upon completion, students must submit the course certificate and marksheet to the department for the credit to be transferred to their BCA program.
- Marksheet will reflect the Course Title of MOOC course done by student

8th Semester (BCA Honours with Research)

S. No.	Course Category	Couse Code	Course Name	Periods				Evaluation scheme		Subject Total
				L	T	P	C	Sessional (Internal)	External (ESE)	
1	Project	BCARP8	Dissertation on Research Project - II	-	-	36	18	150	350	500
			Total			36	18	150	350	500
Exit Option with Bachelor of Computer Applications Degree, BCA Degree (with completion of courses equivalent to a minimum of 132 credits)				**Total Credits (Ist to VIIIth Sem)**			**162**	**Total Marks (Ist to VIIIth Sem)**		**6000**

Students pursuing BCA (Honours with Research) are required to

- Present a paper in a conference/Seminar.

  OR

- One research paper publication in a journal.

1st Semester

Course code	**: BCADSC101**				
Course Name	**: PROGRAMMING IN 'C'**				
Semester /Year	**: 1st Semester / 1st Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the basics of Programming Paradigms,
2. To learn the basic concepts and syntax of C programming.
3. To be able to develop logics which help them to create programs and applications using C language.
4. To learn the use of C libraries functions in C language.
5. To learn the file handling and basic memory allocation concepts in C language.
6. After learning the C programming they can easily switch over to any other language

COURSE CONTENTS

UNIT-I **[No. of Hours: 7]**

History of 'C' Programming, Types of Programming Languages. Introduction to C and structure of 'C' Program, some simple C programs, Desirable program characteristics. C Fundamentals- C character Set, Identifiers and keywords, datatypes, constants, variables and arrays, Declarations, expressions, statements, Symbolic constants.

UNIT –II **[No. of Hours: 10]**

Operators and expressions- Arithmetic operators, unary operator, Relational and logical operators, assignment operators, conditional operators, Library Functions. Data Input and Output- Preliminaries, singe character input, singe character output, entering input data, writing output data, the gets and puts function. Precedence and associatively of operators, Side effects, Type conversion, Managing input and output.

UNIT-III **[No. of Hours: 10]**

Control Statements- Preliminaries, Branching, Looping, Nested control statements, switch statement, break statement, the continue statement. Arrays: Defining an array, processing an array, passing arrays to functions, Multidimensional arrays, Arrays and strings. **Functions:** A brief overview, defining a function, accessing a function, function prototypes, passing arguments to a function, recursion. Storage classes.

UNIT-IV **[No. of Hours:6]**

Pointers- Fundamentals, Pointer declarations, Passing pointers to the functions, pointers and one-dimensional array, dynamic memory allocation, Operations on pointers, arrays of pointers. Pointer to Pointer, call by value call by reference, pointer to function.

UNIT-V **[No. of Hours: 7]**

Structure &Union: Declaration & Initialization of Structure & Union, Array of Structure, passing structure to a function, union and array as member, of union, concept of memory saving and union. Data files- Opening and closing a data file, creating a data file, processing a data file, unformatted data files. Command line argument in 'C'.

Text Books:

TB1. Pointers in C, KanetkarY.P. , BPB Publications
TB2. Kanetkar Y.P., Let us C, BPB Publications

Reference Books:

RB1. The C programming language, Kernighan and Ritchie, PHI
RB2. The Spirit of C, Cooper Mullish, Jaico Publishing House, Delhi

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental syntax, keywords, and constructs of the 'C' programming language.
CO2	Explain the working of C programs, including functions, arrays, and pointers, in their own words.
CO3	Develop programs using C constructs like loops, functions, and arrays to solve computational problems.
CO4	Debug and dissect C programs to identify logical errors and memory management issues.
CO5	Compare and justify the use of different C constructs (e.g., loops vs. recursion) for efficiency and readability.
CO6	Design and implement a modular C project integrating file handling, structures, and pointers.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	2	-	2	-	1	-	-
CO2	3	2	2	1	-	2	-	2	-	2	1	-
CO3	3	3	3	3	1	2	2	3	1	2	1	1
CO4	2	3	3	3	1	2	2	3	1	2	2	1
CO5	2	3	3	3	2	2	2	3	1	2	2	2
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	2.5	2.5	2.5	2.3	1.2	2.2	1.8	2.7	0.8	2	1.5	1.2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP11 (Practical based on BCADSEC101)**				
Course Name	**: PROGRAMMING IN C LAB**				
Semester / Year	**: 1st Semester / 1st Year**				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand basic concepts of C programming, operators and expressions.
2. To learn the Concept of Various Decision Control statements and loops.
3. To understand the Concept of Arrays and String Operations.
4. To understand Concept of Functions, Pointers, Structure, Union and Enumeration.
5. To understand Concept of File Handling

COURSE CONTENTS

- Simple Program based on operators
- Simple Program based on Loops
- Program based on arrays
- Program based on strings
- Program based on function
- Program based on pointers
- Program based on structure & union
- Program based on File handling

Course Outcomes (CO):
After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental syntax, data types, operators, and control structures in C programming.
CO2	Explain the working of C programs involving loops, arrays, and functions.
CO3	Develop and execute C programs using decision-making, loops, and user-defined functions to solve given problems.
CO4	Debug and identify logical errors in C programs by tracing code execution and testing different scenarios.
CO5	Compare and assess the efficiency of different programming approaches (e.g., iterative vs. recursive) for a given problem.
CO6	Design and implement a complete C program integrating multiple concepts (arrays, structures, pointers, and file handling) to solve real-world problems.

CO-PO Mapping:

CO	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	2	-	-	-	1	-	-
CO2	3	2	2	1	-	2	-	-	-	2	-	-
CO3	3	3	3	2	1	2	1	1	1	2	1	1
CO4	2	3	3	3	1	2	1	1	1	2	1	1
CO5	1	3	3	3	2	2	2	1	1	2	2	2
CO6	2	3	3	3	2	3	2	2	2	3	2	3
AVG	2.2	2.5	2.5	2.2	1.3	2.2	1.3	1	1	2	1.3	1.7

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC102**				
Course Name	**: COMPUTER FUNDAMENTAL & INFORMATION TECHNOLOGY**				
Semester /Year	**: 1st Semester / 1st Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide understanding of the various components and functional units of computers, their design and working.
2. To provide insight into digital systems and logic circuit design.

COURSE CONTENTS

UNIT I Introduction to Computers **[No. of Hours: 8]**

Generation of Computer, Hardware Components, Memory Devices, Magnetic Disk, Floppy Disk, Compact Disc/ DVD; Input Devices- Keyboard, Mouse, Scanner, OCR, OMR, MICR. Output Devices- Printer, Types of Printer, Plotter, Monitor: CRT; Central Processing Unit, CPU- Arithmetic Logic Unit, Control Unit, Instruction Set, Registers, Processor Speed, Type Of Processors; Memory- Main Memory Organization, Main Memory Capacity, RAM, ROM, EPROM, PROM, Cache Memory, OCR, OMR, MICR.

UNIT II Number Systems **[No. of Hours: 6]**

Number Systems: Binary, Decimal, Octal, Hexadecimal, Binary Arithmetic, Character Codes (BCD), Excess-3, Gray Code, ASCII

UNIT III –System Software and Application Software **[No. of Hours: 10]**

System software, utility packages, compilers, interpreters, Operating Systems, Elementary commands of DOS, Booting.

Application softwares– word-processing, spreadsheet, presentation graphics, Data Base Management Software, Characteristics, Virus- working, features, types of viruses, virus detection prevention and cure.

UNIT IV - Programming Languages and Algorithms **[No. of Hours: 8]**

Generation of Languages: Machine language, Assembly languages, High level languages, Language translators (Compiler, Interpreter, Assembler) , Syntax error, Logical error, runtime error, General concepts of OOPS (Object oriented programming), Structured Query Language

Algorithm development, techniques of problem solving- Flowchart, Pseudo-code, Decision trees, Programming paradigms: Top-down, bottom-up etc.

UNIT V – Computer Network & Communication Technologies **[No. of Hours: 8]**

Communication system elements, communication modes (simplex, half duplex and full duplex analog and digital, synchronous and Asynchronous, Communication media: wired and wireless, LAN WAN, MAN, network topologies.

Text Books:

TB1. Pradeep K. Sinha, Priti Sinha, "Computer Fundamentals". BPB Publications.
TB2. Rajaraman, V., "Fundamental of Computers". Prentice Hall India, New Delhi
TB3. Dorothy House, "Microsoft Word, Excel, and PowerPoint: Just for Beginners. Outskirts
TB4. Press 2 Peter Norton, "Introduction to Computers",4th Edition, TMH Ltd, New Delhi.

Reference Books:

RB1. Sanders D.H, Computers Today

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental hardware/software components, number systems, and memory types.
CO2	Explain the functions of CPU, OS, networking topologies, and programming paradigms.
CO3	Use binary/hexadecimal conversions and basic SQL queries to solve computational problems.
CO4	Compare different generations of computers, programming languages, and network protocols.
CO5	Assess the suitability of input/output devices, memory hierarchies, and antivirus tools for real-world scenarios.
CO6	Design algorithms (flowcharts/pseudocode) and simple LAN topologies to address given problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	1	2	1	2	1	2	1	1
CO2	3	2	2	2	1	2	2	2	2	2	2	2
CO3	3	3	2	3	1	2	2	3	3	2	2	2
CO4	3	3	3	3	2	3	2	3	2	3	2	2
CO5	2	3	3	3	3	2	3	3	2	2	2	2
CO6	2	3	3	3	2	3	3	3	2	3	3	3
AVG	2.67	2.5	2.33	2.67	1.67	2.33	2.17	2.67	2	2.33	2	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP12 (Lab based on BCADSC102)**				
Course Name	**: COMPUTER FUNDAMENTAL LAB**				
Semester / Year	**: 1st Semester / 1st Year**				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To provide understanding of the various components and functional units of computers, their design and working.
2. To provide insight into digital systems and logic circuit design.

COURSE CONTENTS

- Various Components of Computer
- Internal And External DOS Commands
- Windows Operating System
- MS Word
- MS Excel
- MS Power Point
- Web Browser and E-mail

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Identify and describe the functions of key hardware/software components of a computer system.
CO2	Explain the purpose and usage of internal/external DOS commands and Windows OS features.
CO3	Demonstrate proficiency in creating, formatting, and managing documents (Word), spreadsheets (Excel), and presentations (PPT).
CO4	Troubleshoot basic file/system errors using DOS/Windows tools and analyze data in Excel (e.g., sorting, formulas).
CO5	Assess the effectiveness of different software tools (e.g., Word vs. PPT for reports) and ethical practices in email/internet usage.
CO6	Design an integrated project (e.g., business report with Excel data, Word summary, and PPT presentation) to solve a real-world problem.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	1	-	-	-	1	-	-
CO2	2	2	1	1	-	1	-	-	-	-	-	-
CO3	2	3	2	2	1	-	1	1	1	-	2	1
CO4	1	3	2	3	-	-	-	-	2	-	-	-
CO5	-	2	-	1	3	2	2	1	-	1	2	1
CO6	-	3	3	3	2	2	3	2	1	2	3	3
AVG	**1.6**	**2.2**	**1.8**	**1.8**	**1.2**	**1.2**	**1.2**	**0.8**	**0.8**	**0.8**	**1.4**	**1**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC103**			
Course Name	**: MATHEMATICAL FOUNDATION OF COMPUTER SCIENCE**			
Semester /Year	**: 1st Semester / 1st Year**			
L	**T**	**P**	**C**	
4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Know the basic principle of set theory, relations, function and its operations.
2. Able to Understand the concepts of groups, and elementary properties of Rings and Fields.
3. Learn the logical notation and determine if the argument is or is not valid in preposition and predicate logic.
4. Learn the representation of lattices with POSET.
5. Learn the concepts of graphs, trees and it's traversal, and recurrence relations.

COURSE CONTENTS

UNIT I **[No. of Hours: 8]**

Set Theory: Set, Subset, Operation on sets, DeMorgan's Law, Power set of set. Matrices: Matrices operations, Transpose, Inverse and power of Matrices.

UNIT II **[No. of Hours: 8]**

Relation: Type and compositions of relations, Equivalence relations, Partial ordering relation. Function: Types, Composition of function,

UNIT III **[No. of Hours: 8]**

Mathematical Induction, Discrete Numeric Functions and Generating functions, Simple Recurrence relation with constant coefficients, Linear recurrence relation without constant coefficients

UNIT IV **[No. of Hours: 8]**

Algebric Structures: Properties, Semi group, monoid, Group, Abelian group, properties of group, Subgroup, Cyclic group, Cosets, Permutation groups.

UNIT V **[No. of Hours: 8]**

Prepositional Logic: Preposition, Basic logical operations, Tautologies, Contradictions, Algebra of Proposition, Logical implication, Logical equivalence, quantifiers, Posets, Hasse Diagram.

Text Books:

TB3. Kenneth H. Rosen, "Discrete Mathematics and its applications', TMH.
TB4. Liptschutz, Seymour, "Discrete Mathematics", TMH.".

Reference Books:

RB1. Hopcroft J.E. Uliman J.D., "Introduction to Automata Theory, Language and Computation" Narosa Pub. House, New Delhi.

RB2. C.L.Liu "Elements of Discrete Mathematics", McGraw Hill.

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of set theory, relations, functions, and algebraic structures.
CO2	Explain the properties of matrices, equivalence relations, recurrence relations, and logical propositions with examples.
CO3	Use mathematical induction, matrix operations, and recurrence relations to solve computational problems.
CO4	Compare algebraic structures (groups, semigroups) and analyze their applications in computer science.
CO5	Validate the correctness of logical arguments (tautologies, contradictions) and optimize recurrence solutions.
CO6	Design Hasse diagrams for posets and construct proofs using induction or group theory concepts.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	-	1	-	-	2	1	-	-
CO2	3	2	2	2	-	2	-	-	2	1	-	-
CO3	2	3	3	3	-	2	1	-	1	2	-	1
CO4	2	2	3	3	1	2	2	-	1	2	1	1
CO5	1	3	3	3	2	2	1	-	-	2	1	1
CO6	1	2	3	3	1	3	2	1	-	3	2	2
AVG	2	2.2	2.7	2.5	0.8	2	1.2	0.2	1.2	1.8	0.8	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAGE101**				
Course Name	**: OFFICE AUTOMATION**				
Semester /Year	**: 1st Semester / 1st Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objective:

1 Office tools course would enable the students in crafting professional word documents, excel spread sheets, power point presentations, Database using the Microsoft suite of office tools.
2 To familiarize the students in preparation of documents and presentations with office automation tools.

COURSE CONTENTS

Unit 1: Introduction to MS Office Suite and Microsoft Word **[No. of Hours: 12]**

Overview of Microsoft Office Suite and its applications, Understanding the importance of MS Office in the professional world

Creating, editing, and formatting documents, working with text, fonts, and paragraphs, Page layout, margins, and page numbering, inserting tables, images, and other objects, working with headers and footers, Creating and formatting tables of contents, Introduction to mail merge and document collaboration

Unit 2: Microsoft Excel **[No. of Hours: 10]**

Understanding spreadsheets and their applications, Entering and formatting data in cells, using formulas and functions for calculations, formatting spreadsheets and applying cell styles, creating charts and graphs, Sorting and filtering data, Using conditional formatting and data validation, Introduction to pivot tables and data analysis tools

Unit 3: Microsoft PowerPoint **[No. of Hours: 10]**

Creating and formatting slides, adding text, images, and multimedia elements, applying slide transitions and animations, using slide masters and templates, presenting slideshows and using speaker notes, creating handouts and exporting presentations

Unit 4: Microsoft Access **[No. of Hours: 8]**

Understanding databases and their components, creating tables, forms, queries, and reports, Entering and editing data in tables, Defining relationships between tables, Creating basic queries to retrieve information, Generating reports based on data

Text Books:

TB1. Office 365 All-in-One For Dummies (For Dummies (Computer/Tech)) by Peter Weverka, Timothy L. Warner
TB2. Mastering MS Office by Bittu Kumar
TB3. Word 2019 For Dummies by Dan Gookin

TB4. Microsoft PowerPoint 2010 - Develop Computer Skills: Be Future Ready, by Bittu Kumar.

Reference Books:

RB1. Microsoft Office Step by Step (Office 2021 and Microsoft 365) by Curtis Frye, Joan Lambert

RB2. Word 2019 Beginner (Word Essentials 2019) by M L Humphrey

RB3. Step-By-Step Optimization With Excel Solver The Excel Statistical, Mark Harmon

Course Outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall the core features and functions of MS Office applications (Word, Excel, PowerPoint, Access).
CO2	Explain the purpose of tools like mail merge (Word), PivotTables (Excel), and queries (Access) in professional workflows.
CO3	Demonstrate the ability to create formatted documents (Word), analyze datasets (Excel), and design slideshows (PowerPoint) for real-world tasks.
CO4	Compare and select appropriate MS Office tools (e.g., Excel vs. Access) to solve specific business or technical problems.
CO5	Assess the effectiveness of a presentation (PowerPoint) or database (Access) based on usability, design, and functionality.
CO6	Develop an integrated project (e.g., report + dataset + presentation) using MS Office Suite to address a multidisciplinary problem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	1	1	1
CO2	2	3	2	2	1	1	1	1	2	1	2	1
CO3	3	3	3	3	2	2	2	2	2	2	3	2
CO4	2	3	3	3	1	2	1	2	3	2	1	1
CO5	1	2	2	2	3	1	3	1	2	1	3	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3
AVG	2.3	2.5	2.3	2.3	1.8	1.8	1.8	1.6	2.1	1.6	2.1	1.6

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCASC101**			
Course Name	**: PERSONALITY DEVELOPMENT AND SOFT SKILLS**			
Semester / Year	**: 1st Semester / 1st Year**			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1 Develop effective communication skills, both verbal and non-verbal.
2 Enhance interpersonal skills for building and maintaining positive relationships.
3 Cultivate self-awareness and personal development to enhance professional growth.
4 Acquire problem-solving and decision-making abilities in various contexts.
5 Develop ethical and professional behavior in personal and team settings.
6 Adapt to new technologies and embrace lifelong learning for continuous growth.

COURSE CONTENTS

Unit 1: Personality Development and Communication Skills **[No. of Hours: 8]**
Understanding personality: Key traits, self-awareness, and self-assessment, Verbal and non-verbal communication: Effective speaking, listening, and body language, Public speaking and presentation skills: Structure, delivery, and confidence, Interpersonal communication: Building relationships and resolving conflicts.

Unit 2: Professional Skills and Leadership **[No. of Hours: 7]**
Professionalism: Workplace etiquette, dressing, and ethical behavior, Leadership qualities: Decision-making, team management, and delegation, Emotional intelligence: Empathy, assertiveness, and relationship-building, Networking: Building and maintaining professional connections.

Unit 3: Time Management and Emotional Well-being **[No. of Hours: 5]**
Time management: Goal-setting, prioritization, and productivity tools, Stress management: Identifying stress, coping strategies, and resilience, Work-life balance: Techniques for maintaining emotional well-being.

Text Books:

TB1. "The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" by Stephen R. Covey
TB2. "Emotional Intelligence: Why It Can Matter More Than IQ" by Daniel Goleman
TB3. "Crucial Conversations: Tools for Talking When Stakes Are High" by Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler
TB4. "The Power of Now: A Guide to Spiritual Enlightenment" by Eckhart Tolle
TB5. "How to Stop Worrying and Start Living" by Dale Carnegie
TB6. "Influence: The Psychology of Persuasion" by Robert Cialdini

Reference Books:

RB1. "How to Win Friends and Influence People" by Dale Carnegie
RB2. "The Art of Public Speaking" by Stephen E. Lucas
RB3. "Soft Skills: The Software Developer's Life Manual" by John Sonmez
RB4. "Mindset: The New Psychology of Success" by Carol S. Dweck

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key traits of personality development and principles of effective communication.
CO2	Explain the role of emotional intelligence and professionalism in workplace success
CO3	Demonstrate verbal/non-verbal communication skills in presentations and conflict resolution.
CO4	Assess personal strengths/weaknesses through self-assessment tools (e.g., SWOT).
CO5	Critique peer presentations or case studies on leadership/teamwork using soft skills frameworks.
CO6	Design a time-management plan or a professional networking strategy for career growth.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	2	-	-	-	-	-	1	-
CO2	-	2	2	-	3	1	2	1	-	1	2	2
CO3	-	3	1	-	2	-	1	2	-	-	3	2
CO4	-	2	2	-	3	2	1	-	-	2	1	3
CO5	-	1	2	-	3	1	3	-	-	1	2	3
CO6	-	1	3	-	2	3	3	2	-	3	1	2
AVG	**0**	**1.7**	**2**	**0**	**2.5**	**1.3**	**1.7**	**1**	**0**	**1.3**	**1.7**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: AEC1**				
Course Name	**: ENVIRONMENTAL STUDIES-I**				
Semester / Year	**: 1st Sem / 1st Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Unit I. Humans and the Environment

Course Learning Outcomes

After completing this unit, students will be able to:

- Appreciate the historical context of human interactions with the environment.
- Gain insights into the international efforts to safeguard the Earth's environment and resources.

Unit Outline

- Human population growth: Impacts on environment, human health and welfare
- Dams: Resettlement and rehabilitation of project-affected persons (case studies)
- Disaster management: Floods, earthquake, cyclones and landslides
- Environmental movements: *Chipko*, Silent valley, *Bishnois* of Rajasthan
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Suggested readings

1 Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2 Headrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3 Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4 Perman, R., Ma, Y., McGilvray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5 Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press

Unit II. Natural Resources and Sustainable Development

Course Learning Outcomes

After completion of this unit, students would be able to:

- Understand the concept of natural resources; identify types of natural resources, their distribution and use with special reference to India.
- Discuss the factors affecting the availability of natural resources, their conservation and management.

- Explain sustainable development, its goals, targets, challenges and global strategies for sustainable development.

Unit Outline

- Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable.
- Forest resources: Types, threats and conservation strategies.
- Water resources: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges;
- Water scarcity and stress; Conflicts over water.
- Soil and mineral resources: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation.
- Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy
- Introduction to sustainable development: Sustainable Development Goals (SDGs)- targets and indicators, challenges and strategies for SDGs.

Suggested readings

1 Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/ Cummins/ Pearson.
2 John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS).
3 William P. Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA).
4 Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson).
5 Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals.

Unit III. Environmental Issues: Local, Regional and Global

Course Learning Outcomes

After completion of this unit, students would be able to:

- Develop a critical understanding of the environmental issues of concern
- Understand the concepts of spatial and temporal scales and their importance
- Understand the sectoral effects on the local, regional, and global environmental issues

Unit Outline

- Pollution: Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog.
- Land use and Land cover change: land degradation, deforestation, desertification, urbanization.

- Global change: Ozone layer depletion; Climate change. Disasters – Natural and Man-made (Anthropogenic).

Suggested Readings

1 Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
2 Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
3 William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
4 Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
5 Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.

Unit IV. Conservation of Biodiversity and Ecosystems

Course Learning Outcomes

After completion of this unit, students would be able to:

- Understand the concepts of ecosystems, biodiversity and conservation.
- Describe the main types of ecosystems and their distribution.
- Discuss the factors impacting biodiversity loss and ecosystem degradation.
- Explain major conservation strategies taken in India.

Unit Outline

- Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity hotspots; Species and ecosystem threat categories.
- Ecosystems and ecosystem services: Major ecosystem types in India and their basic characteristics-forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance.
- Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change.
- Major conservation policies: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge.

Suggested Readings

1 Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
2 Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
3 Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
4 Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
5 Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK.

Unit V. Case Studies & Fieldwork

- Discussion on one national case study related to the environment and sustainable development.
- Documentation of campus biodiversity.
- Documentation of the biodiversity of any nearby terrestrial/aquatic ecosystem.
- Participation in plantation drives and nature camps.
- Case Studies on any one Natural Disaster: Kedarnath Disaster, Tsunami 2004, Bhuj Earthquake).
- Prepare a report on Environmental Impacts of the Tehri Dam.
- Prepare a report on any one environmental movement of India: (*Chipko*, Silent valley, *Bishnois* of Rajasthan).
- Prepare a map highlighting the protected areas of India.

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall and list the major environmental challenges faced by humanity, including population growth, resource depletion, pollution types, and the impact of human-made structures such as dams.
CO2	Comprehend the concepts of sustainable development, the classification of natural resources, and the significance of biodiversity and ecosystem services.
CO3	Demonstrate the ability to document biodiversity in various ecosystems, participate in environmental conservation activities like plantation drives, and use knowledge of environmental issues in real-world contexts.
CO4	Examine and interpret the causes and effects of major environmental problems, including land degradation, deforestation, and climate change, and analyze the environmental impact of over-exploitation of resources.
CO5	Assess the effectiveness of various conservation policies, both national and international, in preserving biodiversity and ecosystems, and critique the role of different environmental movements in India.
CO6	Design and construct detailed reports on specific environmental case studies, such as the Tehri Dam's impact, and produce maps highlighting the protected areas of India.

CO –PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	1	1	1	1	1	2	2	2
CO2	3	2	2	3	1	2	1	1	1	3	2	2
CO3	2	3	3	2	2	2	2	2	1	3	3	3
CO4	2	3	3	3	2	2	2	2	2	3	3	3
CO5	1	2	2	3	3	2	2	2	1	2	2	2
CO6	2	3	3	2	2	2	3	2	2	3	3	3
AVG	**2**	**2.5**	**2.5**	**2.67**	**1.83**	**1.83**	**1.83**	**1.67**	**1.33**	**2.67**	**2.5**	**2.5**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: CITVC101**				
Course Name	**: COMPUTERS AND ETHICS**				
Semester / Year	**: 1st Sem / 1st Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

- Understand ethical considerations in computing and information technology.
- Explore the ethical dimensions of privacy, cybersecurity, and social media.
- Analyze the ethical implications of emerging technologies and artificial intelligence.
- Apply ethical decision-making models to resolve ethical dilemmas in computing.
- Evaluate the social and cultural impacts of technology on society.
- Develop ethical guidelines for responsible technology use and development.

COURSE CONTENTS

Unit 1: Foundations of Ethics in Computing **[No. of Hours: 7]**

Introduction to ethical theories and decision-making frameworks, Historical perspectives on computers and ethics, Privacy and data protection: concepts, ethical issues in data handling, and legal frameworks, Privacy implications of emerging technologies (e.g., IoT, biometrics)

Unit 2: Intellectual Property and Cybersecurity Ethics **[No. of Hours: 7]**

Intellectual property rights, software piracy, and open-source software ethics, Digital rights management and fair use, Fundamentals of cybersecurity and ethical hacking, Ethical and legal issues in vulnerability disclosure and organizational security

Unit 3: AI, Social Media, and Societal Impacts **[No. of Hours: 6]**

Ethical issues in AI: algorithm bias, transparency, and socioeconomic impacts, social media ethics: responsible behavior, privacy risks, and algorithmic impacts, Cyberbullying and online hate speech, Digital divide, technology addiction, and ethical responsibilities of tech professionals

Text Books:

TB1. Computers and Society: Modern Perspectives by by Ronald M. Baecker

TB2. THE HANDBOOK OF INFORMATION AND COMPUTER ETHICS by Kenneth Einar Himma and Herman T. Tavani.

Reference Books/ Online Resources

RB1. "Ethics for the Information Age" by Michael J. Quinn

RB2. "Ethics in Information Technology" by George Reynolds

RB3. "Ethics in Computing: A Concise Module" by Joseph Migga Kizza

RB4. "Information Ethics: Privacy, Property, and Power" by Adam D. Moore

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall core ethical theories (e.g., utilitarianism, deontology) and key legal frameworks (e.g., GDPR) relevant to computing.
CO2	Explain ethical dilemmas in computing (e.g., privacy vs. security, AI bias) using appropriate terminology.
CO3	Use ethical decision-making frameworks to propose solutions for real-world scenarios (e.g., data breaches, software piracy).
CO4	Compare the ethical implications of emerging technologies (e.g., IoT, biometrics) on societal stakeholders.
CO5	Assess the validity of arguments in cybersecurity ethics (e.g., vulnerability disclosure) or intellectual property disputes.
CO6	Design an ethical guideline/policy for a tech company addressing a specific issue (e.g., AI transparency, social media accountability).

CO –PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	1	-	-	-	1	-	-
CO2	-	2	1	-	3	-	-	-	-	-	1	-
CO3	2	3	2	2	3	-	1	1	-	-	2	1
CO4	1	2	2	3	2	2	-	-	-	1	-	-
CO5	-	3	2	3	3	-	2	-	-	-	2	2
CO6	-	2	3	2	3	3	3	2	-	2	3	3
AVG	1.2	2.3	1.8	2	2.7	1.5	1.5	1	-	1	1.8	1.5

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

2nd Semester

Course code	**:**	**BCADSC201**			
Course Name	**:**	**DATA STRUCTURE & FILE ORGANIZATION**			
Semester / Year	**:**	**2nd Semester / 1st Year**			
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn basic knowledge about data structure and arrays.
2. To learn how to create and use linked list and its applications.
3. To learn the importance of static and dynamic use of stack and queues.
4. To learn the basic terminology of trees.
5. To learn basics of sorting and searching techniques

COURSE CONTENTS

UNIT I **[No. of Hours: 6]**

Introduction: Basic Terminology, Elementary Data Organization, Data Structure operations, Algorithm Complexity and Time-Space trade-off. Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Character String in C, Character string operation, Array as Parameters, Ordered list, Sparse Matrices, and Vector.

UNIT II **[No. of Hours: 8]**

Link List: Representation and implementation of Singly linked lists, Two-way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List of Array, Polynomial representation and addition, Generalized linked list, Garbage Collection and Compaction.

UNIT III **[No. of Hours: 8]**

Stacks: Array Representation and Implementation of stack, Operations and Stacks: Push and POP, Array Representation of Stack, Linked Representation of stack, Operations Associated with Stacks, Application of stack, Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack. Recursion: Recursive definition and processes. Queues: Array and linked representation and implementation of queues, Operations on Queue; Create, Add, Delete, Full and Empty, Circular queue, Dequeue and Priority Queue.

UNIT IV **[No. of Hours: 10]**

Trees: Basic terminology, Binary Tree, Binary tree representation algebraic Expressions, Complete Binary Tree, Extended Binary Tree, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees. Tree traversing, Threaded Binary tree, Huffman

algorithm. Searching and Hashing: Sequential search, comparison and analysis, Hash Table, Hash Function, Collection Resolution Strategies, Hash Table Implementation.

UNIT V **[No. of Hours: 8]**

Sorting: Insertion Sort, Bubble sorting, Quick Sort, Two way Merge Sort, Trees: Binary Search (BST), Insertion and Deletion in BST.

Text Books:

TB1. Lipschutz, "Data Structure", TMH

Reference Books:

RB1. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia

RB2. R. Kruseetal, "Data Structures and Program Design in C" Pearson Education

COURSEOUTCOMES(CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of data structures (arrays, linked lists, stacks, queues, trees) and their terminologies.
CO2	Explain the working principles, operations, and applications of various data structures
CO3	Implement basic data structure operations and algorithms using C.
CO4	Compare time-space complexities of different data structures and algorithms.
CO5	Assess the efficiency of a given data structure or algorithm for a specific problem.
CO6	Design and develop optimized solutions for real-world problems (e.g., file compression using Huffman coding, database indexing using B-trees).

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	-	1	2	1	-	-
CO2	3	2	2	2	-	1	1	2	2	1	1	1
CO3	3	2	3	3	1	2	2	3	3	2	2	2
CO4	3	3	3	3	-	2	2	2	2	2	1	1
CO5	2	3	3	3	2	2	3	2	3	2	2	2
CO6	3	3	3	3	2	3	3	3	3	3	3	3
AVG	2.8	2.3	2.5	2.5	1.4	1.8	2	2.2	2.5	1.8	1.8	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP21 (Lab based on BCADSC201)**				
Course Name	**: DATA STRUCTURE & FILE ORGANIZATION LAB**				
Semester / Year	**: 2nd Semester / 1st Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn how to design the algorithms to solve the programming problems.
2. To learn how to discriminate the usage of various structures in approaching the problem solution.
3. To learn how to use effective and efficient data structures in solving various Computer Engineering domain problems
4. To learn how to analyse the problems to apply suitable algorithm and data structure.
5. To learn how to use appropriate algorithmic strategy for better efficiency

COURSE CONTENTS

- Program based on arrays
- Program based on strings
- Program based on Link List & types of Link List
- Program based on stack
- Program based on Queues
- Program based on Trees
- Program based on different types of sorting

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental data structures, their properties, and basic file organization techniques.
CO2	Explain the working principles of various data structures and file access methods with appropriate examples.
CO3	Implement basic operations (insertion, deletion, searching) on different data structures using programming languages.
CO4	Compare time/space complexity of different data structures and select appropriate ones for given problem scenarios.
CO5	Assess the efficiency of different file organization methods for specific application requirements.
CO6	Design and develop integrated solutions combining multiple data structures and file handling techniques for real-world problems.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	2	2	1	1
CO2	3	2	2	2	1	2	1	1	2	2	2	1
CO3	3	3	3	3	1	2	2	2	2	2	1	2
CO4	3	3	3	3	1	2	2	2	2	2	1	2
CO5	2	3	3	3	2	2	3	2	3	2	2	2
CO6	2	3	3	3	2	3	3	3	3	3	3	3
AVG	2.67	2.5	2.5	2.5	1.33	2.17	2	1.83	2.33	2.17	1.67	1.83

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC202**				
Course Name	**: JAVA PROGRAMMING**				
Semester / Year	**: 2nd Semester / 1st Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Demonstrate proficiency in Java syntax, control structures, and OOP concepts to write structured programs.
2. Apply exception handling and multithreading techniques to develop efficient and error-resistant applications.
3. Design interactive GUI applications using Java Swing and integrate them with databases via JDBC.
4. Analyze and debug Java programs to optimize performance and ensure logical correctness.

COURSE CONTENT

Unit 1: Introduction to Java and Basic Programming Constructs **[No. of Hours:8]**

History and features of Java, JVM, JRE, JDK, installing JDK and IDE (e.g., Eclipse/IntelliJ), writing first Java program, primitive and reference data types, type casting, arithmetic, relational, logical, bitwise, and assignment operators, if-else, switch, for, while, do-while loops, defining methods, method parameters, return types, method overloading.

Unit 2: Object-Oriented Programming in Java **[No. of Hours:10]**

Classes and objects, encapsulation, inheritance, polymorphism, abstraction, creating classes, constructors, this keyword, extends, super, method overriding, dynamic method dispatch, abstract classes, abstract methods, interfaces, default methods, creating and using packages, public, private, protected, default access modifiers.

Unit 3: Core Java Advanced Features **[No. of Hours:10]**

Exception handling with try-catch, throw, throws, custom exceptions, String class, StringBuilder, StringBuffer, string operations, reading and writing files, File class, streams, thread creation, synchronization, thread lifecycle.

Unit 4: Java Swing and JavaBeans **[No. of Hours:6]**

JFrame, JPanel, JLabel, JButton, JTextField, FlowLayout, BorderLayout in Java Swing, ActionListener, MouseListener, event delegation model, JavaBeans concepts, properties, creating and using beans, getter and setter methods.

Unit 5: JDBC for Database Connectivity **[No. of Hours:6]**

JDBC architecture, database drivers, steps to connect to a database, connecting to a database (e.g., MySQL), executing SELECT, INSERT, UPDATE, DELETE queries, PreparedStatement, ResultSet, dynamic queries, batch processing, integrating JDBC with Swing for a database-driven GUI application.

Text Books:

TB1. A. Balaguruswamy, "Programming with JAVA", A Primer, TMH, 1999.

Reference Books:

RB1. Thomas Boutel, "CGI programming in C and Perl", Addison – Wesley, 1996.
RB2. Jefry Dwight et al, Using CGI, Prentice Hall, India, 1997.
RB3. Patrick Naughton& Herbert Schildt, JAVA 2: The Complete Reference, THM, 1999.
RB4. Schildt, "JAVA The Complete Reference",

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall Java syntax, data types, operators, and control structures to explain basic programming constructs.
CO2	Describe OOP principles (encapsulation, inheritance, polymorphism) and Java features (JVM, packages, exceptions) with examples.
CO3	Develop Java programs using methods, loops, and classes to solve computational problems.
CO4	Analyze exception handling strategies and multithreading synchronization techniques to debug and optimize Java programs.
CO5	Assess exception handling strategies and JDBC workflows to debug and secure database applications.
CO6	Design a GUI application using Swing and JDBC to integrate OOP concepts, event handling, and database connectivity.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1′	2	1	1	1	2	1	1
CO2	3	2	3	2	1	2	1	2	1	2	2	2
CO3	3	3	3	3	1	2	2	2	1	2	2	2
CO4	2	3	3	3	2	2	2	2	1	2	2	2
CO5	2	3	3	3	2	2	3	3	3	2	2	3
CO6	2	3	3	3	3	3	3	3	3	3	3	3
AVG	2.5	2.5	2.8	2.5	1.7	2.2	2	2.2	1.7	2.2	2	2.2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP22 (Lab based on BCADSC202)**			
Course Name	**: CORE JAVA LAB**			
Semester / Year	**: 2nd Semester / 1st Year**			
L	**T**	**P**	**C**	
0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To teach the students basics of JAVA programs and its execution.
2. To teach the students the differences between C++ and Java programming.
3. To make the students learn concepts like packages and interfaces.
4. To make the students understand threads.
5. To make the students understand the usage util package.
6. To teach the student, to develop java programs using inheritance and interfaces.
7. To understand exceptional handling, command line arguments and file handling

Course Outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental Java concepts including data types, operators, control structures, and OOP principles.
CO2	Explain Java features like inheritance, polymorphism, exception handling, and multithreading with appropriate examples.
CO3	Develop Java programs using classes, objects, packages, and interfaces to solve basic programming problems.
CO4	Compare and contrast different Java approaches (like interface vs abstract class) and debug programs by analyzing runtime errors.
CO5	Test and validate Java programs for correctness, efficiency, and adherence to coding standards.
CO6	Design and implement integrated Java applications combining multiple concepts (GUI, database connectivity, file handling) to solve real-world problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	-	-	-	1	-	-
CO2	3	2	2	1	-	2	-	-	-	1	1	1
CO3	3	3	3	2	1	2	1	1	1	2	1	1
CO4	2	3	3	3	1	2	1	1	1	2	2	2
CO5	1	3	2	3	2	2	2	1	2	2	2	2
CO6	2	3	3	3	3	3	3	2	3	3	3	3
AVG	2.33	2.5	2.33	2.17	1.4	2	1.4	1	1.4	1.83	1.5	1.5

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC203**				
Course Name	**: DIGITAL ELECTRONICS**				
Semester / Year	**: 2nd semester / 1st year**				
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
2. To understand common forms of number representation in digital electronic circuits and to be able to convert between different representations.
3. To implement simple logical operations using combinational logic circuits.
4. To design combinational logic circuits, sequential logic circuits.

COURSE CONTENTS

Unit 1 **[No. of Hours: 6]**

Binary Systems and Logic Circuits: The Advantage of Binary, Number Systems- Binary, Octal, Decimal and Hexadecimal. Conversions between number systems. Use of Binary in Digital Systems, Logic Gates, Logic Family Terminology.

Unit 2 **[No. of Hours: 6]**

Binary Arithmetic: Binary Addition, Subtraction, Multiplication and Division. Complements, Representation of Signed and Unsigned numbers – Signed magnitude , Signed 1's Complement, Signed 2's complement, Decimal subtraction using 9's and 10's complement, Binary subtraction using 1's and 2's complement.

Unit 3 **[No. of Hours: 8]**

Boolean Algebra and Mapping Methods: Boolean Algebra, SOP and POS forms of representation, minterms and maxterms, Simplification of logic functions by theorems and Karnaugh's map, don't care conditions, Realizing Logic Function with Gates, Combinational Design Examples.

Unit 4 **[No. of Hours: 10]**

Combinational Logic: Adders- Half adder and full adders, Subtractors- Half and Full Subtractors, Encoders and Decoders, Multiplexers and De-multiplexers.

Unit 5 **[No. of Hours: 10]**

Sequential Logic: Latch, Flip Flops- SR, Data, JK & Toggle

Registers: Serial-in-Serial-Out, Serial-in-Parallel-Out, Parallel-in-Serial-Out, Parallel-in-Parallel-Out Shift registers

Counters- Synchronous and Asynchronous/ Ripple counters, Design of Ripple counter - Modulo-n counter.

Text Books:

TB5. M. M. Mano, Digital Design, Pearson Education, Delhi.
TB6. D.P. Leach, Malvino, Guha, Digital Principles and Applications, TMH, New Delhi.

Reference Books:

RB1. T. L. Floyd and Jain, Digital Fundamentals, Pearson Education, 2003.
RB2. R.J. Tocci and N.S. Widner, Digital Systems - Principles & Applications, PHI.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO1	Recall fundamental concepts of binary systems, number conversions, and logic gate functionalities
CO2	Explain Boolean algebra theorems, combinational/sequential circuits, and signed number representations.
CO3	Design basic combinational circuits (e.g., adders, multiplexers) using logic gates and K-maps.
CO4	Compare trade-offs between logic families (TTL/CMOS) and debug timing issues in sequential circuits.
CO5	Assess the efficiency of circuit designs (e.g., power, speed) and validate results using simulations.
CO6	Build a functional digital system (e.g., counter, ALU) by integrating combinational and sequential logic

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	1	2	1	1
CO2	3	2	2	2	1	2	1	2	2	2	2	1
CO3	3	3	3	3	1	2	2	3	2	2	2	2
CO4	2	3	3	3	2	2	2	3	1	2	2	2
CO5	2	3	3	3	2	3	3	3	1	3	2	2
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	**2.5**	**2.5**	**2.5**	**2.5**	**1.7**	**2.3**	**2**	**2.7**	**1.5**	**2.3**	**2**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAGE201**				
Course Name	**: CYBER SECURITY**				
Semester / Year	**: 2nd Semester / 1st Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Learn the foundations of Cyber Security and threat landscape.
2. To equip students with the technical knowledge and skills needed to protect and
3. defend against cyber threats.
4. To develop skills in students that can help them plan, implement, and monitor
5. cyber security mechanisms to ensure the protection of information technology assets.
6. To expose students to governance, regulatory, legal, economic, environmental,
7. social and ethical contexts of Cyber Security.
8. To expose students to responsible use of online social media network.
9. To systematically educate the necessity to understand the impact of cybercrimes
10. and threats with solutions in a global and societal context.
11. To select suitable ethical principles and commit to professional responsibilities and human values and contribute value and wealth for the benefit of the society

COURSE CONTENTS

UNIT I Introduction to Cyber Security **[No. of Hours: 6]**

Overview of cyberspace, internet, and web technology. Basics of internet infrastructure, governance, and cyber security concepts. Key issues and challenges in cyber security.

UNIT II Cybercrime and Cyber law **[No. of Hours: 8]**

Types of cybercrimes (e.g., targeting computers, financial frauds, social engineering, malware). Reporting and mitigating cybercrimes. Overview of IT Act, 2000, and organizations handling cybercrime in India.

UNIT III Social Media Overview and Security **[No. of Hours: 10]**

Introduction to social media platforms, privacy, and marketing. Security risks, handling inappropriate content, relevant laws, and best practices

UNIT IV E-Commerce and Digital Payments **[No. of Hours: 8]**

E-commerce components, security threats, and best practices. Digital payment methods (UPI, e-Wallets, banking cards), common frauds, preventive measures, and RBI guidelines.

UNIT V Digital Devices Security, Tools and Technologies for Cyber Security

[No. of Hours: 8]

Endpoint and mobile device security, password policies, patch management, backups, and third-party software safety. Importance of firewalls, antivirus, Wi-Fi security, and basic security configurations.

Text Books:

TB1. Cyber Crime Impact in the New Millennium, by Marine R. C, Auther Press.
TB2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.

Reference Books:

RB1. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
RB2. Electronic Commerce by Elias M. Awad, Prentice Hall of India Pvt Ltd.
RB3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers.
RB4. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2nd Edition, Wiley India Pvt. Ltd.
RB5. Fundamentals of Network Security by E. Maiwald, McGraw Hill.

Course outcomes (COs):

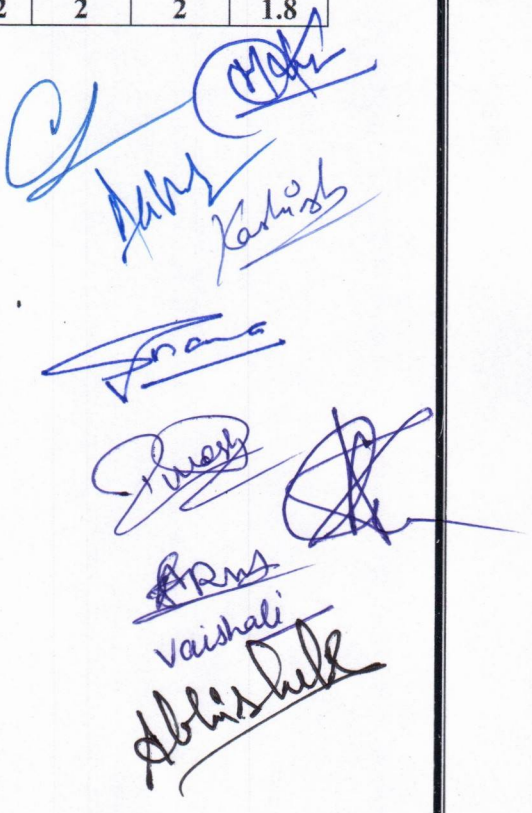
After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of cyberspace, internet infrastructure, and cyber threats.
CO2	Explain cybercrime classifications, legal frameworks (IT Act 2000), and mitigation strategies.
CO3	Implement security best practices for social media, e-commerce, and digital payments.
CO4	Investigate real-world cyberattacks (e.g., malware, phishing) using case studies and identify vulnerabilities.
CO5	Assess the effectiveness of security policies, tools (firewalls, antivirus), and compliance with RBI guidelines.
CO6	Design a cybersecurity awareness or a secure digital payment prototype.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	2	3	2	2	3	1	1	2	1	1	2	1
CO3	3	2	3	3	2	2	2	2	2	2	2	2
CO4	2	3	2	3	2	2	1	2	1	2	2	2
CO5	1	2	3	2	3	2	2	3	1	2	2	2
CO6	1	2	3	2	2	3	3	3	1	3	3	3
AVG	**2**	**2.2**	**2.2**	**2.2**	**2.2**	**2**	**1.7**	**2.2**	**1.2**	**2**	**2**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



Course code	**: BCASC201**				
Course Name	**: LEADERSHIP SKILLS**				
Semester / Year	**: 2nd Semester / 1st Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1 Understand the principles and theories of effective leadership.
2 Develop essential communication and interpersonal skills for leading teams.
3 Apply decision-making and problem-solving techniques in leadership scenarios.
4 Analyze different leadership styles and their suitability in various contexts.
5 Evaluate personal leadership strengths and areas for improvement.
6 Create a comprehensive leadership plan for project management and team leadership.

COURSE CONTENTS

Unit 1: Leadership Foundations **[No. of Hours: 6]**

Definition and Importance: Core concepts of leadership and its critical role in the technology industry, **Key Qualities**: Essential characteristics of effective leaders (e.g., integrity, adaptability, vision). **Leadership Theories and Styles**: Overview of trait, behavioral (autocratic, democratic, laissez-faire), and transformational leadership; introduction to situational leadership.

Unit 2: Effective Leadership Skills **[No. of Hours: 7]**

Communication: Verbal and non-verbal communication, active listening, emotional intelligence, and concise presentation skills, **Decision-Making and Problem-Solving**: Key decision-making models, critical thinking, creativity, and conflict resolution techniques.

Unit 3: Leading Teams and Projects **[No. of Hours: 7]**

Team Building and Management: Stages of team development (forming, storming, norming, performing), motivation, delegation, and managing team dynamics, **Project Leadership**: Setting goals, managing time and resources, and addressing risks in projects, **Ethical Leadership**: Values-based leadership, ethical decision-making, and personal growth through self-awareness and continuous learning.

Text Books:

TB1. "Leadership: Theory and Practice" by Peter G. Northouse
TB2. "The Leadership Challenge" by James M. Kouzes and Barry Z. Posner
TB3. "Leading Teams: Setting the Stage for Great Performances" by Richard Hackman
TB4. "The 21 Irrefutable Laws of Leadership: Follow Them and People Will Follow You" by John C. Maxwell

Reference Books:

RB1. "Good to Great: Why Some Companies Make the Leap... and Others Don't" by Jim Collins

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key leadership theories, styles, and qualities (e.g., trait, transformational, situational leadership).
CO2	Explain the role of communication, emotional intelligence, and ethics in effective leadership.
CO3	Demonstrate decision-making models (e.g., SWOT) to solve team or project challenges.
CO4	Compare leadership approaches for different tech scenarios (e.g., crisis vs. innovation).
CO5	Assess team dynamics and ethical dilemmas using case studies or simulations.
CO6	Design a leadership strategy for a multidisciplinary tech project, incorporating motivation, delegation, and risk management.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	2	1	-	-	-	1	-	1
CO2	-	2	1	-	3	2	-	1	-	2	2	2
CO3	-	3	2	2	1	-	2	-	-	-	3	3
CO4	2	2	3	3	-	1	1	-	1	1	1	3
CO5	-	1	2	2	3	-	3	-	-	2	2	3
CO6	1	3	3	3	2	3	3	2	2	3	2	3
AVG	**1**	**2.2**	**2.2**	**2**	**2.2**	**1.4**	**2.2**	**0.5**	**0.5**	**1.8**	**1.8**	**2.5**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: AEC2**				
Course Name	**: COMMUNICATION SKILLS: LISTENING AND SPEAKING SKILLS**				
Semester /Year	**: 2nd Semester / 1st Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

The objectives of this course are-

1. To communicate appropriately in real-life situation.
2. To use English effectively for study and communicative purpose for successful career.
3. To develop and integrate the use of two language skills- Listening and Speaking.
4. To understand different types of theories and needs of communication.

Course Contents

Unit 1: Introduction: Theory of Communication

Definition and function of Communication, Needs For effective Communication, Process of communication

Unit 2: Listening Skills

Types of Listening, Developing effective listening skills,
Listening to Talks and Presentation, Monologue, dialogue, miscommunication

Unit 3: Speaking Skills

Interview, Public speech, Mock interviews and Group discussions

Reference Books:

1. Dangwal, Surekha. *The Art Effective Communication.* Delhi: Macmillan.
2. Prasad, P. *The Functional Aspects of Communication skills*, Delhi
3. Sen, Leena. *Communication Skills*, Prentice hall of India, New Delhi.
4. McCarty, Michel. *English Vocabulary in Use*, Cambridge University Press.
5. Communication Skill by Sanjay Kumar & Pushp Lata, Oxford University Press
6. An Introduction to Professional English and Soft Skills by B.K. Das, Cambridge University.

Course outcomes (COs):

Upon successful completion of the course a student will be able -

CO1	To memorize the functions of communication and related topics.
CO2	To explain listening and speaking skills.
CO3	To acquire necessary listening and speaking skills in order to follow and comprehend discourse.
CO4	To organize vocabulary and improve accuracy in grammar.
CO5	To select positive attitudes for English Communication.
CO6	To implement communicative skills at interviews, presentations and Group discussions for successful career skills.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	2	1	1	1	1	2	3	2
CO2	1	3	1	1	2	1	1	1	1	1	3	2
CO3	1	3	2	1	2	2	2	1	1	2	3	2
CO4	1	2	1	1	2	2	1	1	1	1	3	2
CO5	1	2	1	1	3	1	1	1	1	2	3	2
CO6	1	3	2	2	3	2	2	2	1	2	3	3
AVG	**1.17**	**2.67**	**1.33**	**1.17**	**2.33**	**1.5**	**1.33**	**1.17**	**1**	**1.67**	**3**	**2.17**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: CITVC201**				
Course Name	**: THE ART OF CLEAN CODE**				
Semester / Year	**: 2nd Sem / 1st Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

- Understand the principles of clean code and its significance in software development.
- Apply coding standards and best practices for writing readable and maintainable code.
- Analyze and refactor existing code to eliminate code smells and improve code quality.
- Implement design patterns to enhance code structure and flexibility.
- Develop effective unit tests using Test-Driven Development (TDD) principles.
- Evaluate and optimize code performance to identify and resolve bottlenecks.
- Create software projects showcasing clean code practices and design patterns.

COURSE CONTENTS

Unit 1: Foundations of Clean Code **[No. of Hours: 6]**

Definition and Importance: Understanding clean code and its impact on software development, **Code Readability**: Naming conventions, meaningful identifiers, formatting, and indentation, **Documentation**: Effective commenting and documentation practices, **Key Principles**: Introduction to SOLID, and DRY principles.

Unit 2: Refactoring, Testing, and Optimization **[No. of Hours: 8]**

Refactoring: Identifying code smells and applying common refactoring techniques, **Unit Testing**: Writing effective unit tests and basics of Test-Driven Development (TDD), **Debugging and Error Handling**: Techniques for debugging and proper exception management, **Performance Optimization**: Identifying and addressing performance bottlenecks.

Unit 3: Design Patterns and Collaboration **[No. of Hours: 6]**

Design Patterns: Overview of Creational, Structural, and Behavioral patterns with practical examples, **Version Control**: Using Git for version control and collaboration, **Code Reviews and Quality**: Conducting code reviews and using code quality metrics/tools.

Text Books:

TB1. Clean Architecture: A Craftsman's Guide to Software Structure and Design by Robert C. Martin
TB2. Code Complete: A Practical Handbook of Software Construction by Steve McConnell
TB3. Working Effectively with Legacy Code by Michael C. Feathers

Reference Books/ Online Resources

RB1. Refactoring: Improving the Design of Existing Code by Martin Fowler
RB2. Design Patterns: Elements of Reusable Object-Oriented Software by Erich Gamma
RB3. Test-Driven Development: By Example by Kent Beck

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key principles of clean code (SOLID, DRY) and common code smells.
CO2	Explain the impact of readability, documentation, and design patterns on software maintainability.
CO3	Demonstrate refactoring techniques and unit testing (TDD) to improve existing code.
CO4	Diagnose performance bottlenecks and debug errors using systematic approaches.
CO5	Assess code quality through reviews, metrics, and adherence to best practices.
CO6	Design a modular, well-documented software solution using clean code principles and version control (Git).

CO –PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	1	1	-	-	-	1	-	-
CO2	3	2	3	2	2	2	-	-	-	2	-	-
CO3	2	3	3	3	1	2	2	1	1	2	1	1
CO4	1	3	2	3	-	1	1	-	2	1	-	-
CO5	-	2	2	2	3	1	3	2	-	1	3	3
CO6	2	3	3	3	2	3	3	3	2	3	2	3
AVG	2.2	2.5	2.5	2.3	1.8	1.7	2.2	1.5	1.3	1.7	1.5	1.8

3rd Semester

Course code	**: BCADSC301**				
Course Name	**: ANDROID PROGRAMMING**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. This course facilitates classroom and laboratory learning.
2. Letting students develop competence and confidence in android programming.
3. Understand the entire Android Apps Development Cycle.
4. Enable the students to independently create Android Applications.
5. Access and work with databases under the Android operating system.

COURSE CONTENT

Unit 1: Introduction to Android and Development Environment **[No. of Hours: 8]**

Introduction to Android OS, features, versions, and architecture, Android app structure and components., Setting up Android Studio and SDK, Creating and running the first Android application, Project structure and file system in Android Studio, Debugging and basic troubleshooting.

Unit 2: User Interface Design **[No. of Hours: 8]**

Android UI components: Views, ViewGroups, Layouts, Layout types: Linear, Relative, Constraint, Frame, UI controls: Buttons, TextViews, EditTexts, ImageViews, CheckBoxes, RadioButtons, Event handling (onClick, onLongClick, etc.), Toasts and Snackbars, Creating responsive UI using styles and themes.

Unit 3: Activity, Intents, and Fragments **[No. of Hours: 8]**

Activity lifecycle and state management, Intents: Explicit and Implicit, Data passing between activities, Working with Fragments and fragment lifecycle, Fragment transactions and back stack, Creating multi-screen applications.

Unit 4: Data Storage and Background Processing **[No. of Hours: 8]**

Shared Preferences for data storage, Internal and external storage access, SQLite database integration, Reading and writing files, Introduction to AsyncTask and background threads, Notifications and services (basic introduction).

Unit 5: Advanced Features and App Deployment **[No. of Hours: 8]**

Using multimedia: Playing audio and video, Accessing device sensors: Camera, GPS (location services), Introduction to Google Maps integration, Permissions in Android, Preparing the app for release and APK generation, Publishing app to Google Play.

Text Books:

TB1. Sayed Y Hashimi and Satya Komatineni, "Pro Android", Wiley India Pvt. Ltd.
TB2. Android application development for java programmers. By James C. Sheusi. Publisher: Cengage Learning.

Reference Books:

RB1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education2nd edition.
RB2. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
RB3. Mark L Murphy, "Beginning Android", Wiley India Pvt. Ltd.

Course Outcome (COs):

Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Recall key components of Android architecture (Activities, Services, Fragments) and development tools (Android Studio, Gradle)
CO2	Explain the lifecycle of Android components (Activity, Fragment) and the role of Intents in inter-component communication.
CO3	Develop functional UIs using layouts (ConstraintLayout, LinearLayout) and event handlers (onClick, onLongPress).
CO4	Diagnose performance issues in Android apps (e.g., UI lag, memory leaks) using debugging tools (Logcat, Profiler).
CO5	Assess the trade-offs between data storage options (SharedPreferences, SQLite, Files) for a given use case.
CO6	Design and build a complete Android app with multimedia (camera/GPS), data persistence, and deployment-ready APK.

Mapping of PO and CO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	2	3	2	2	1	1	1	1	1	1	1	1
CO3	1	2	3	2	1	1	2	1	1	1	2	2
CO4	1	3	2	3	1	2	1	1	2	2	1	1
CO5	1	2	1	3	2	1	1	1	3	1	1	1
CO6	1	2	3	3	3	3	3	3	2	3	3	3
AVG	1.5	2.2	2	2.3	1.5	1.7	1.5	1.3	1.7	1.7	1.5	1.5

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP31 (Lab based on BCADSC301)**				
Course Name	**: ANDROID PROGRAMMING LAB**				
Semester / Year	**: 3rd Semester / 2nd Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Install and configure Android application development tools.
2. Design and develop user Interfaces for the Android platform.
3. Apply Java programming concepts to Android application development.
4. Apply essential Android Programming concepts.
5. Develop various Android applications related to layouts & rich uses interactive interfaces

COURSE CONTENTS

1. Program to show method overloading in java.
2. Program to show method overriding in java.
3. Program to use abstract class in java.
4. Program to implement interface in java.
5. Program to use the concept of multithreading in java.
   a)using Thread class
   b)using Runnable interface.
6. Program to multilevel inheritance in java.
7. Write an Android App to create dialog box.
8. Program to use final keyword in java.
9. Program to use super in java.
10. Program to handle exceptions encountered in java.
11. Android program to print hello world
12. Android program to print addition of two numbers.
13. Android program to create a calculator.
14. Android program to create implicit intent.
15. Android program to create explicit intent.
16. Android program to create toggle button.
17. Android program to create spinner.
18. Android program to create EMI calculator.
19. Android program to use image view.
20. Android program to use different type of layouts.

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

CO #	Detailed Statement of the CO
CO1	Recall fundamental components of Android (Activities, Intents, Fragments, UI elements) and their roles in app development.
CO2	Explain the Android lifecycle, event handling, and data storage mechanisms (SharedPreferences, SQLite).
CO3	Develop functional Android apps using layouts, activities, and basic data persistence techniques.
CO4	Debug and optimize Android apps by diagnosing performance issues, memory leaks, and UI responsiveness.
CO5	Assess the security, usability, and efficiency of Android applications based on best practices.
CO6	Design and deploy a fully functional Android application integrating multiple components (UI, database, APIs) following industry standards.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	-	-	-	-	-	-
CO2	3	1	2	1	-	1	-	-	2	1	-	-
CO3	2	2	3	2	1	2	1	1	3	1	1	1
CO4	1	2	3	3	1	2	2	1	1	2	-	1
CO5	-	2	2	3	3	2	1	2	-	1	2	1
CO6	1	3	3	3	2	3	3	3	2	2	3	3
AVG	1.7	1.7	2.5	2	1.2	1.7	1.2	1.2	1.3	1.2	1	1

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC302**				
Course Name	**: WEB PROGRAMMING**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Understand the fundamentals of web programming, including HTML structure, basic tags, and webpage design considerations.
2. Create and format web content using text elements, lists, and hyperlinks for effective navigation and organization.
3. Incorporate images, tables, and IFrames into webpages to enhance layout and user interaction.
4. Develop interactive web forms and apply CSS for styling, including text formatting, margins, borders, and responsive design.
5. Implement basic JavaScript functionalities, such as variables, functions, event handling, and DOM manipulation, to build dynamic webpages.

COURSE CONTENTS

Unit I: Introduction to Web Programming and HTML Basics **[No. of Hours: 6]**

Introduction to the Internet, Introduction to HTML Terminology, Designing a Webpage: Design Considerations and Planning, Basic Tags and Document Structure, HTML Tags: Head Tags, Title Tags, Body Tags, Metadata, Saving an HTML Page, Page Formatting: Adding a New Paragraph, Line Breaks, Inserting Blank Space, Preformatted Text, Changing Background Color, Div Element

Unit II: Text, Lists, and Links **[No. of Hours: 6]**

Text Items and Objects: Headings, Comments, Block Quotes, Horizontal Lines, Special Characters, Creating Lists: Numbered (Ordered) Lists, Bulleted (Unordered) Lists, Nested Lists, Definition Lists, Links: Text Links, Image Links, Opening Pages in New Window/Tab, Setting All Links to Open in New Window/Tab, Bookmarks, Linking to Email, Linking to Other File Types

Unit III: Images, Tables, and IFrames **[No. of Hours: 8]**

Images: Adding Images to Webpages, Resizing Images, Alternative (ALT) Text, Image Labels, Basic Tables: Inserting Tables, Table Borders, Table Headers, Colspan and Rowspan, IFrames: Introduction to IFrames, Inserting IFrames, Setting Height and Width, Using IFrames as Link argets

Unit IV: Forms and CSS **[No. of Hours: 10]**

Forms: Text Boxes, Text Areas, Checkboxes, Menu Lists, Radio Buttons, Submit and Reset Buttons, Changing Tab Order, Sending to Email, Event Handling, Cascading Style Sheets: CSS Introduction, CSS Syntax, External CSS, Linking CSS, Comments in CSS, Internal Style Sheets, ID and Class, Inline Styling, CSS Text Styling: Bold and Italic, Decoration, Indentation,

Transformation, Text Alignment, Fonts, Font Sizes, Letter Spacing, Text Color, Margins, Padding, Borders, Styling Links, List Styles, Sizing Elements, Text Wrapping, Shadowing

Unit V: Introduction to JavaScript **[No. of Hours: 10]**

Introduction to JavaScript: Overview, Syntax, and Embedding JavaScript in HTML, Variables, Data Types, and Operators, Functions: Defining and Calling Functions, Events: Handling User Interactions (e.g., onclick, onmouseover), DOM Manipulation: Accessing and Modifying HTML Elements, Basic Control Structures: Conditionals (if-else) and Loops (for, while), Introduction to JavaScript Libraries: Overview of jQuery, Simple Interactive Features: Form Validation, Dynamic Content Updates

Text Books:

TB1. HTML & CSS: The Complete Reference, Fifth Edition, Thomas A. Powell.
TB2. IvanBayross, "Web Technologies Part-I" BPB Publications

Reference Books:

RB1. Burdman, "Collaborative Web Development", Addison Wesley
RB2. Sharma & Sharma, "Developing E-Commerce Sites" Addison Wesley

Course Outcomes (COs):

After completion of the course, a student will be able to

CO#	DESCRIPTION
CO1	Recall HTML tags, CSS properties, and JavaScript syntax to describe their functions.
CO2	Explain how HTML structures content, CSS styles layouts, and JavaScript adds interactivity.
CO3	Build a static webpage using HTML/CSS and integrate basic JavaScript event handlers.
CO4	Debug and fix errors in HTML/CSS/JS code by analyzing browser developer tools.
CO5	Assess the usability, accessibility, and responsiveness of a given webpage.
CO6	Design and deploy a dynamic website with forms, styled layouts, and interactive features using HTML, CSS, and JavaScript.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	3	2	2	2	2	2	1	1	1	2	1	1
CO3	3	2	3	3	2	2	2	2	1	2	2	2
CO4	2	3	3	3	2	2	2	2	1	2	2	2
CO5	1	3	2	3	3	2	3	3	1	2	3	3
CO6	3	3	3	3	3	3	3	3	2	3	3	3
AVG	**2.5**	**2.3**	**2.3**	**2.5**	**2.2**	**2.2**	**2**	**2**	**1.2**	**2.2**	**2**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest

Course code	**: BCAP32 (Lab based on BCADSC302)**				
Course Name	**: WEB PROGRAMMING LAB**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Creating and structuring webpages using HTML tags, including text formatting, lists, and hyperlinks.
2. Implement images, tables, and IFrames to enhance webpage layout and functionality.
3. Design and develop interactive web forms with various input elements and basic event handling.
4. Apply CSS styling techniques, including external, internal, and inline styles, to improve webpage appearance.
5. Write and execute basic JavaScript programs to manipulate the DOM, handle events, and validate forms.

Course Outcomes (COs):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall basic HTML, CSS, and JavaScript syntax and tags.
CO2	Explain the structure and styling of web pages using HTML and CSS.
CO3	Develop functional web pages using forms, links, images, tables, and CSS.
CO4	Analyze web page elements and user interactions to improve design and usability.
CO5	Evaluate web applications for proper functionality, responsiveness, and user experience.
CO6	Design and build dynamic, interactive web projects integrating HTML, CSS, and JavaScript.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	2	-	2	-	2	2	2
CO2	3	3	2	2	-	2	-	2	-	2	2	2
CO3	3	3	3	3	-	3	2	3	-	3	3	3
CO4	3	3	3	3	-	3	2	3	-	3	3	3
CO5	2	3	3	3	2	3	3	3	-	3	3	3
CO6	3	3	3	3	2	3	3	3	-	3	3	3
AVG	**2.83**	**2.83**	**2.67**	**2.5**	**2**	**2.67**	**2.5**	**2.67**	**-**	**2.67**	**2.67**	**2.67**

Course code	**: BCADSC303**				
Course Name	**: COMPUTER NETWORK**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Build an Understanding of the Fundamental Concepts of Computer Networking.
2. Familiarize the Student with the Basic Taxonomy and Terminology of the Computer Networking Area.
3. Introduce the Student to Advanced Networking Concepts
4. Preparing the Student for Advanced Courses in Computer Networking.

COURSE CONTENTS

Unit I **[No. of Hours: 8]**

Introductory Concepts: Goals and Applications of Networks, Network structure and transmission, switching methods, Integrated services digital networks, terminal handlIng.

Unit II **[No. of Hours: 8]**

Medium Access sub Layer: Channel allocations, LAN protocols, ALOHA Protocols-Pure Aloha, slotted ALOHA, Carrier Sense Multiple Access Protocols, CSMA with Collision Detection, Collision free Protocols, IEEE standards, FDDI, Data Linked Layer elementary data link protocols, sliding windows protocols, error handling, High Level Data Link Control.

Unit III **[No. of Hours: 8]**

Network Layer: Point-to Point networks, routing algorithms, congestion control algorithms, internetworking, TCP/IP packet, IP addresses, Ipv6.

Unit IV **[No. of Hours: 8]**

Transport Layer: Design issues, connection management, TCP window Management, User Datagram Protocol, Transmission Control Protocol.

Unit V **[No. of Hours: 8]**

Application Layer: Network Security, DES, RSA algorithms, Domain Name System, Simple Network Management Protocol, Electronic mail, File Transfer Protocol, Hyper Text Transfer Protocol, Cryptography and compression Techniques.

Text Books:

TB1. Forouzan, "Data Communication and Networking:. TMH
TB2. A.S. Tanenbaum, "Computer Networks", PHI

Reference Books:

RB1. Comer, "Internetworking with TCP/IP" PHI
RB2. Comer, "Computer networks & Inter" PHI

Course outcomes (COs):

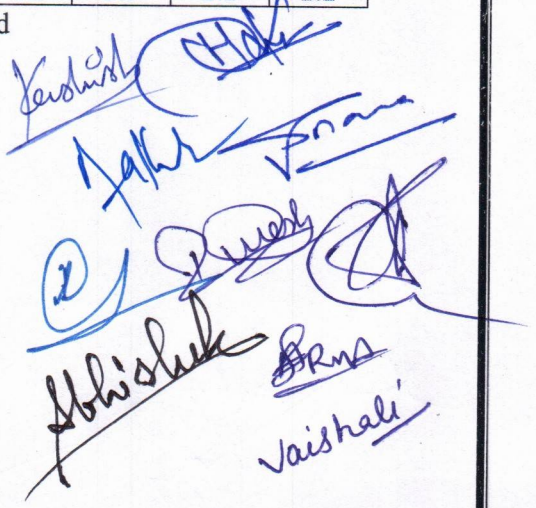
Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental networking concepts, protocols (e.g., TCP/IP, HTTP), and IEEE standards.
CO2	Explain the working of MAC protocols (ALOHA, CSMA/CD), routing algorithms (RIP, OSPF), and transport layer services (TCP/UDP).
CO3	Configure network components (subnets, routers) using tools like Packet Tracer/Wireshark and implement elementary data link protocols.
CO4	Compare switching techniques (circuit vs. packet), congestion control mechanisms, and cryptographic algorithms (DES vs. RSA).
CO5	Assess network security risks (e.g., sniffing, DDoS) and justify protocol choices (e.g., IPv6 adoption) for real-world scenarios.
CO6	Design a secure LAN/WAN topology with optimized routing, firewall rules, and application-layer services (DNS, FTP).

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	1	2	1	1
CO2	3	2	2	2	1	2	1	2	1	2	2	2
CO3	3	3	3	3	2	3	2	3	2	3	2	3
CO4	3	3	3	3	2	2	2	2	1	2	2	2
CO5	2	3	2	3	3	2	2	3	1	2	3	2
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	**2.7**	**2.5**	**2.3**	**2.5**	**2**	**2.3**	**1.8**	**2.5**	**1.3**	**2.3**	**2.2**	**2.2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated



Course code	**: BCAGE301**				
Course Name	**: SYSTEM ANALYSIS & DESIGN**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To study different types of system and life cycle of system development.
2. To learn roles of system analyst and different information gathering tools.
3. To learn use tools for structured analysis, cost/benefit strategies and feasibility study.
4. To learn process and stages of system design and form design.
5. To learn system testing and quality assurance with proper hardware and software selection.

COURSE CONTENTS

Unit I **[No. of Hours: 6]**

System Concepts and Information System Environment- The System Concept, Definition, Characteristics of Systems, Elements of a System, Open and Closed and closed system, Formal and Informal Information Systems, Computer based Information Systems, Management Information System, Decision Support System

Unit II **[No. of Hours: 10]**

The System Development Life Cycle- Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance. The Role of the Systems Analyst, Academic and Personal Qualifications, Skills of System Analyst

Unit III **[No. of Hours: 12]**

Systems Planning and Initial Investigation- Strategies for Determining Information Requirement, Problem Definition and Project initiation, Background Analysis, Fact Analysis, Review of Written Documents, Onsite Observations, Interviews and Questionnaires, Fact Analysis, Performance Analysis, Efficiency Analysis, Service Analysis. Information Gathering- Kind of Information needed. Information about the firms, Information gathering tools, the art of Interviewing, Arranging the Interview, Guides to Successful Interview, Types of Interviews and Questionnaires, The Structured and Unstructured Alternatives.

Unit IV **[No. of Hours: 8]**

The Tools of Structured Analysis- The Dataflow Diagram (DFD), Data Dictionary, Decision Table, Decision Trees and Structured English.

Unit V **[No. of Hours: 4]**

Input/Output and Forms Design- Input Design, CRT Screen Design, Output Design, Requirements form Design.

Text Books:

TB1. Elias M.Awad, "Systems Analysis and Design" Galgotia Publication
TB2. System Analysis and Design Handbook: V. K. Jain, Wiley dreamtech

Reference Books:

RB1. Hoffer, "Modern Systems Analysis and Design" Addision Wesley
RB2. Kendall, "Introduction to System Analysis and Desogm", McGraw Hill

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Defining the concept of system, analysis, design, system analyst and system development life cycle.
CO2	Understand and describe the work done during the development of a system.
CO3	Apply the fact-finding techniques to collect information to generate the system's requirements for the development of a system constructs.
CO4	Analyze the system using data flow diagram, data dictionary and process specification tools to understand how each process is working and connected to others. Analyze the GUI, input/output screen and reports layouts.
CO5	Evaluate the system planning tools and techniques and testing of software projects to ensure its correctness and completeness.
CO6	Implement the newly developed system and giving training to the users.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	1	1	1	1
CO2	2	2	2	2	1	1	3	2	1	1	1	2
CO3	1	3	2	3	2	1	2	3	1	1	3	2
CO4	2	3	3	3	1	2	2	3	2	2	2	2
CO5	1	2	2	3	3	1	3	2	1	1	1	2
CO6	1	2	3	3	3	2	3	3	1	2	3	3
AVG	**1.67**	**2.17**	**2.17**	**2.5**	**1.83**	**1.5**	**2.33**	**2.5**	**1.17**	**1.33**	**1.83**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCASC301**				
Course Name	**: BIG DATA ANALYTICS**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Explain core Big Data concepts (3Vs), ecosystem (Hadoop, Spark), and storage systems (HDFS, NoSQL).
2. Implement data processing workflows using MapReduce, Spark, and query tools (Hive, Pig).
3. Perform descriptive, predictive, and prescriptive analytics on large datasets using statistical/ML methods.
4. Assess privacy, security, and scalability issues in Big Data solutions, including regulatory compliance (GDPR).
5. Build a complete Big Data pipeline for real-world problems.

COURSE CONTENTS

Unit 1: Introduction to Big Data **[No. of Hours: 6]**

Overview of Big Data: Definition, characteristics (volume, velocity, variety); Big Data vs. traditional data; Applications and industry use cases.

Big Data Ecosystem and Technologies: Introduction to Hadoop, Spark, and NoSQL databases; Overview of cloud-based Big Data platforms.

Data Storage and Management: Distributed file systems (HDFS); Data lakes vs. data warehouses; Data ingestion techniques.

Unit 2: Big Data Processing and Analytics **[No. of Hours: 7]**

Data Processing Frameworks: MapReduce paradigm; Spark architecture and RDDs; Batch vs. stream processing.

Big Data Analytics Techniques: Descriptive, predictive, and prescriptive analytics; Statistical methods for Big Data; Visualization tools.

Querying and Data Retrieval: Introduction to Hive and Pig; SQL-like querying for Big Data; Real-time analytics concepts.

Unit 3: Advanced Topics and Ethical Issues **[No. of Hours: 6]**

Machine Learning in Big Data: Scalable ML algorithms; Integration with Spark MLlib; Case studies in Big Data ML.

Big Data Architecture and Workflow: End-to-end Big Data pipeline; Data integration and ETL processes; Scalability and fault tolerance.

Ethics and Challenges in Big Data: Data privacy and security; Ethical considerations in data handling; Regulatory frameworks (e.g., GDPR).

Text Books:

TB1. VK Jain, "Big Data & Hadoop", Khanna Book Publishing Co. [P] Ltd.
TB2. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media.
TB3. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley.

References Books:

RB1. Robert D. Schneider , "Hadoop for Dummies", Wiley publication
RB2. Bernard Marr, "Big Data In Practice", Wiley publication
RB3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer.
RB4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of Big Data (3Vs), Hadoop ecosystem, and NoSQL databases.
CO2	Explain the differences between batch (MapReduce) and stream processing (Spark), and data storage systems (HDFS, data lakes).
CO3	Implement basic Big Data workflows (e.g., data ingestion using Flume/Kafka, querying with Hive/Pig).
CO4	Compare Big Data tools (Hadoop vs. Spark) and architectures (data lake vs. warehouse) for specific use cases.
CO5	Assess ethical and regulatory challenges (GDPR, bias) in Big Data projects and propose mitigation strategies.
CO6	Design an end-to-end Big Data pipeline using Hadoop/Spark for a real-world problem.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	2	1	1	1
CO2	3	2	2	2	1	2	1	2	3	1	1	1
CO3	3	3	3	3	1	2	2	3	3	2	2	2
CO4	2	3	3	3	1	2	2	2	3	2	1	2
CO5	1	2	1	1	3	1	1	1	1	2	3	2
CO6	3	3	3	3	2	3	3	3	3	3	2	3
AVG	2.5	2.3	2.2	2.2	1.5	2	1.7	2.2	2.5	1.8	1.7	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: AEC3**				
Course Name	**: ENVIRONMENTAL STUDIES-II**				
Semester / Year	**: 3rd Sem / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Unit I. Environmental Pollution and Health

Course Learning Outcomes

After completing this unit, students would be able to:

- Develop an understanding of pollution and its types.
- Learn about sources of different kinds of pollution.
- Sensitize themselves to adverse health impacts of pollution.

Unit Outline

- Definition of pollution; Point sources and non-point sources of pollution.
- Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants; Other important air pollutants- (VOCs), (PAN), (PAHs) and (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards.
- Water pollution: Sources of water pollution; river, lake and marine pollution, groundwater pollution; water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.
- Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.
- Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.
- Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

Suggested Readings

1. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
2. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
3. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
4. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/
5. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).

Unit II. Climate Change: Impacts, Adaptation and Mitigation

Course Learning Outcomes

After completing this unit, students would be able to:

- Gain a comprehensive knowledge of climate change, its science and response measures
- Have an overview of national and global efforts to address climate change adaptation and mitigation.

Unit Outline

- Structure of atmosphere; Climate Change, GHGs (greenhouse gas emissions).
- Paris Agreement; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment.
- Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change.
- Mitigation of climate change: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality.
- National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.

Suggested Readings

1. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
2. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
3. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
4. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
5. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.

UNIT III. Environmental Management

Course Learning Outcomes

After completion of this unit, students would be able to:

- Develop a critical understanding of the complexity of environmental management.
- Understand broad aspects of environmental management systems.
- Understand different methods of assessing environmental quality and associated risks.

Unit Outline

- Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.
- Environmental management system: ISO 14001. Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis.
- Environmental audit and impact assessment; Environmental risk assessment Pollution control and management.
- Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling /Eco mark scheme.

Suggested Readings

1. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A transdisciplinary Approach. CRC Press.
2. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
3. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
4. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
5. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

Unit IV. Environmental Treaties and Legislation

Course Learning outcomes

After completion of this unit, students would be able to:

- Learn about how the nations of the world work together for the environment.
- Learn about the major international treaties and our country's stand on and responses to the major international agreements.
- Learn about major international institutions and programmes and the role played by them in the
- protection and preservation of the environment.

Unit Outline

- Major International Environmental Agreements: Convention on Biological Diversity (CBD); Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Montreal Protocol on Substances that Deplete the Ozoné Layer and the Kigali Amendment; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions.
- Major Indian Environmental Legislations: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; Noise Pollution (Regulation and Control) Rules, 2000; Waste management rules.
- National Green Tribunal; United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization
- (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.

Suggested Readings

1. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5

2. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp-content/uploads/2020/02/convention-V-16-CURVE-web.pdf
3. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
4. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/
5. Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi.org/10.2139/ssrn.3311406

Unit V. Case Studies & Fieldwork

- Discussion on one international case study related to the environment and sustainable development.
- Field visits to identify local/regional environmental issues, make observations including data collection and prepare a brief report.
- Participation in cleanliness drives and nature camps.
- Campus environmental management activities such as solid waste disposal and management.
- Campus environmental management activities such as water management and sanitation, and sewage treatment.
- Case Studies on any one Pollution related Disaster: (Bhopal Gas Tragedy, Chernobyl Disaster, London smog, Delhi Smog, Minamata Disaster).
- Prepare a brief report on any one Environment related Treaty/Protocol: (Kyoto Protocol, Montreal Protocol, CITES, Paris Agreement, CBD).
- Prepare a map highlighting the Ramsar Sites of India.

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key concepts, definitions, and types of environmental pollution, major international environmental agreements, and fundamental principles of environmental management.
CO2	Understand the sources and impacts of different types of pollution on human health and ecosystems, the intricacies of climate change, and the significance of international environmental treaties and domestic legislations.
CO3	Apply knowledge to identify local and regional environmental issues during field visits, participate in environmental management activities, and document observations on various environmental topics.
CO4	Analyze the causes and effects of environmental disasters, the implications of environmental treaties and protocols, and evaluate the effectiveness of different environmental management systems.
CO5	Assess the global and national efforts in addressing climate change, the effectiveness of environmental laws and regulations, and the role of major international institutions and programmes in environmental conservation.

CO6	Design and formulate reports on specific environmental case studies, such as pollution-related disasters and international treaties, and create informative maps highlighting significant environmental sites, like the Ramsar Sites of India.

CO –PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	1	1	1	1	1	2	1
CO2	1	2	2	2	3	1	1	1	1	2	2	2
CO3	1	3	2	2	2	2	2	1	1	2	3	2
CO4	1	3	2	3	2	2	2	1	1	2	3	3
CO5	1	2	2	2	3	2	2	1	1	2	2	2
CO6	1	2	2	2	3	2	3	1	1	2	2	2
AVG	**1**	**2.33**	**1.83**	**2**	**2.5**	**1.67**	**1.83**	**1**	**1**	**1.83**	**2.33**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: CITVC301**				
Course Name	**: INTRODUCTION TO DATA SCIENCE**				
Semester / Year	**: 3rd Semester / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Introduce core concepts of data science, including data types, statistics, and the role of data scientists in solving real-world problems.
2. Develop hands-on skills in data collection, cleaning, visualization, and basic machine learning.
3. Train students to perform exploratory data analysis (EDA), identify patterns, and derive actionable insights from structured/unstructured datasets.
4. Highlight ethical challenges in data science, including bias, privacy, and security, to foster responsible data-driven decision-making.
5. Enable students to design and present end-to-end data science projects, integrating technical skills with teamwork and communication (CRISP-DM framework).

COURSE CONTENTS

Unit 1: Foundations of Data Science **[No. of Hours: 6]**

Introduction to Data Science: Overview, importance, and applications; Role of data scientists; Types of data (structured, unstructured, semi-structured).

Data Collection and Preprocessing: Data sources; Data cleaning techniques; Handling missing data; Data transformation and normalization.

Basic Statistics for Data Science: Descriptive statistics (mean, median, mode, variance); Probability basics; Data distributions (normal, binomial).

Unit 2: Data Analysis and Visualization **[No. of Hours: 7]**

Exploratory Data Analysis (EDA): Techniques for EDA; Identifying patterns and outliers; Correlation and causation.

Data Visualization: Principles of effective visualization; Tools (e.g., charts, graphs, heatmaps); Interpreting visual data.

Introduction to Data Science Tools: Overview of Python/R for data science; Introduction to libraries (e.g., Pandas, Matplotlib).

Unit 3: Introduction to Machine Learning and Ethics **[No. of Hours: 7]**

Fundamentals of Machine Learning: Supervised vs. unsupervised learning; Basic algorithms (e.g., linear regression, k-means clustering); Model evaluation basics.

Data Science Workflow: CRISP-DM framework; Steps from problem definition to deployment; Case studies.

Ethics and Challenges in Data Science: Data privacy and security; Bias in data and algorithms; Ethical considerations in data-driven decisions.

Text Books

TB1. Pandas for everyone, Python Data Analysis by Daniel Y. Chen, Pearson publication

TB2. Laura Igual, Santi Seguí, "Introduction to Data Science - A Python Approach to Concepts,

Reference book:

RB1. Wes McKinney, "Python for Data Analysis", O'Reilly

RB2. Luca Massaron, John Paul Mueller, "Python for Data Science for Dummies"

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of data science, including data types (structured/unstructured), descriptive statistics, and key terminologies.
CO2	Explain the data science workflow (CRISP-DM), ethical challenges, and the role of visualization in interpreting data.
CO3	Perform data preprocessing (cleaning, normalization) and basic statistical analysis.
CO4	Identify patterns, outliers, and correlations in datasets using exploratory data analysis (EDA) techniques.
CO5	Assess the appropriateness of machine learning models (e.g., linear regression vs. clustering) for given problems and critique ethical implications of data-driven decisions.
CO6	Design and present a complete data science project (from data collection to visualization) to solve a real-world problem.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	1	1	2	1	1	1
CO2	2	2	2	2	3	2	1	1	1	2	2	1
CO3	3	2	3	3	1	3	2	2	3	2	1	2
CO4	2	3	3	3	1	2	2	2	2	2	2	2
CO5	1	2	2	2	3	2	2	2	1	2	2	2
CO6	2	3	3	3	2	3	3	3	2	3	3	3
AVG	**2.2**	**2.2**	**2.5**	**2.3**	**1.8**	**2.3**	**1.8**	**1.8**	**1.8**	**2**	**1.8**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

4th Semester

Course code	**: BCADSC401**				
Course Name	**: DATABASE MANAGEMENT SYSTEM**				
Semester / Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C → Credit

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop expertise related to the following:-

1. Develop a broad understanding of database concepts and database management system software, data models, schemas and instances, data constraints, relational algebra and calculus.
2. Acquire Knowledge to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.
3. Be able to write SQL commands to create and manipulate databaseobjects.
4. Be able to discuss importance of normalization and improve the database design by applying various normal forms.

COURSE CONTENT

Unit I **[No. of Hours: 7]**

Database fundamental concepts, Advantages and Disadvantages of DBMS, Database Administrator, Architecture of DBMS, Schema and Sub Schema, Data Models: Hierarchical data Model, Network Data Model, Relational Data Model.

Unit II **[No. of Hours: 7]**

Keys: Super Key, candidate key, Primary key, Foreign Key; Referential Integrity, Entity, Attribute, Relationship, Generalization and Specialization, Entity – Relationship (E-R) Data Model,

Unit III **[No. of Hours: 8]**

Relationship Degree, Relational Algebra, Relational calculus: Tuple relational calculus, Domain relational calculus.

Unit IV **[No. of Hours: 10]**

Database design and Normalization: Function Dependency, Lossless – Join Decomposition, Dependency Preservation, Anomalies in a database, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF

Unit V **[No. of Hours: 10]**

SQL: Creating table, DDL, DML, Restricting and Sorting Data, Single-Row Functions, Aggregated Data Using the Group Functions, Joining, Sub queries, Keys.

Text Books:

TB1. Elmsari and Navathe, "Fundamental of Database System", Addison Wesley. New York.
TB2. H.Korth & A. Silberschatz, "DATABASE SYSTEM CONCEPTS", TMH.

Reference Books:

RB1. Date. CJ, "An Introduction to Database System", Narosa Publishing House. New Delhi.
RB2. Desai, B, "An Introduction to Database Concepts", Galgotia Publications. New Delhi.
RB3. Ullman. J.D, "Principles of Database Systems", Galgotia Publications, New Delhi.

Course Outcome (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental DBMS concepts (architecture, data models, keys) and SQL syntax.
CO2	Explain ER diagrams, relational algebra operations, and normalization principles (1NF to BCNF).
CO3	Construct SQL queries (DDL, DML, joins, subqueries) and implement databases using normalization rules.
CO4	Diagnose anomalies in database design and decompose tables using functional dependencies.
CO5	Assess the efficiency of database schemas and SQL queries for real-world scenarios.
CO6	Design a normalized database schema for a given problem statement using ER modeling and SQL.

Mapping of PO and CO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	3	2	1	1
CO2	3	2	2	2	1	2	1	2	3	2	1	1
CO3	3	3	3	3	1	2	2	3	3	2	2	2
CO4	2	3	3	3	2	1	2	2	3	1	1	2
CO5	2	3	3	3	2	1	3	2	3	1	2	2
CO6	2	3	3	3	2	2	3	3	3	2	3	3
AVG	**2.5**	**2.5**	**2.5**	**2.5**	**1.5**	**1.67**	**2**	**2.33**	**3**	**1.67**	**1.67**	**1.83**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP41 (Lab based on BCADSC401)**				
Course Name	**: DATABASE MANAGEMENT SYSTEM LAB**				
Semester / Year	**: 4th Semester / 2nd Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Working expertise of DDL and DML commands with their application on solving real time problems.
2. Ability to apply filters using where clause and nested queries, integrity constraints at table level and column level and to use built-in functions including numeric, character and date functions.
3. Adequate knowledge to fetch data from multiple tables using different types of JOIN operations.

Course contents

- SQL queries for Data Definition and Data Manipulation Language.
- SQL queries using logical operations (=,<,>,etc)
- SQL queries using SQL operators
- SQL query using character, number, date and group functions
- SQL queries for relational algebra
- SQL queries for extracting data from more than one table
- SQL queries for sub queries, nested queries

COURSE OUTCOMES (COs):

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

CO #	Detailed Statement of the CO
CO1	Recall the syntax and structure of SQL queries for data definition and manipulation.
CO2	Understand the application of SQL operators, logical operations, and relational algebra in query writing.
CO3	Apply SQL queries to extract and manipulate data using functions, joins, and subqueries.
CO4	Analyze complex SQL queries to optimize data retrieval from multiple tables.
CO5	Evaluate SQL queries for accuracy, efficiency, and correctness using nested and subquery techniques.
CO6	Create optimized and complex SQL queries to solve real-world database problems.

Mapping of PO and CO:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	3	2	1	1
CO2	3	2	1	2	1	2	1	1	3	2	1	1
CO3	3	3	2	2	1	3	1	2	3	3	2	2
CO4	3	3	3	3	1	3	2	2	3	3	2	2
CO5	3	3	3	3	1	3	2	2	3	3	2	2
CO6	3	3	3	3	1	3	3	3	3	3	3	3
AVG	**3**	**2.5**	**2.2**	**2.3**	**1**	**2.7**	**1.7**	**1.7**	**3**	**2.7**	**1.8**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC402**			
Course Name	**: OPERATING SYSTEM**			
Semester / Year	**: 4th Semester / 2nd Year**			
L	**T**	**P**	**C**	
3	**0**	**0**	**3**	

L - Lecture T – Tutorial P – Practical C – Credit

COURSE OBJECTIVES:

1. To study types of Operating System and Process Management.
2. To learn Scheduling and Process Synchronization.
3. To study Deadlock and its prevention and avoidance.
4. To study about Virtual Memory and File Management.
5. To learn Disc Management.

COURSE CONTENTS

UNIT 1 **[No. of Hours: 8]**

Introduction: Operating System- Definition, Types of OS- Simple batch system, Time sharing systems, Real time systems, Multiprocessor systems, Distributed systems, System components - OS Services, System Calls.

UNIT 2 **[No. of Hours: 8]**

Process concepts: PCB, Process Scheduling, Operations on Processes, Co-operating process, IPC, Threads- Overview, Benefits, User & Kernel Threads.
CPU Scheduling, Scheduling criteria, Pre-emptive & Non-preemptive scheduling, Scheduling algorithms

UNIT 3 **[No. of Hours: 8]**

Process Synchronization: Background, Critical Section problem, Critical Regions, Synchronization hardware, Semaphores, Classic Problems of Synchronization
Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

UNIT 4 **[No. of Hours: 8]**

Memory Management: Logical vs. Physical address space, Swapping, Contiguous memory allocation, Non-Contiguous memory allocation- Paging, Segmentation, Segmentation with paging.
Virtual Memory: Background, Demand paging - Performance, Page replacement, Page replacement algorithms (FCFS, LRU, Optimum), Allocation of frames, Thrashing.

UNIT 5 **[No. of Hours: 8]**

File Systems: File concept, access methods, Allocation methods-contiguous, linked and index allocation, Directory System – single level, tree structured, File protection.
Disk Management: Secondary storage structure: Disk structures, Disk Scheduling, Disk Performance Parameter.

Text Books:

TB1. Abraham Silberschatz, Peter Baer Galvin & Greg Gagne, "Operating System Concepts", Sixth Edition, John Wiley & Sons, Inc.

Reference Books:

RB1. Milankovic M "Operating System concepts and Design", Tata Mcgraw hill.
RB2. Deitel H.M. "An Introduction to Operating Sysems" , Pearson Education.

Course Outcomes (COs):

After completion of the course, a student will be able to

CO	Detailed Statement of the CO
CO1	Recall fundamental OS cqncepts (types, services, system calls) and terminologies (PCB, thrashing, deadlock).
CO2	Explain process scheduling algorithms, synchronization techniques, and memory management strategies.
CO3	Implement CPU scheduling algorithms (e.g., Round Robin, SJF) and synchronization tools (semaphores).
CO4	Compare paging vs. segmentation, and evaluate deadlock prevention/avoidance methods.
CO5	Assess the efficiency of page replacement algorithms (LRU, FIFO) and disk scheduling policies.
CO6	Design a solution for a real-world OS problem (e.g., thread-safe producer-consumer, file system layout).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	3	2	2	2	1	2	1	1	2	2	1	1
CO3	2	3	3	3	1	2	2	2	1	2	2	2
CO4	2	3	3	3	1	2	2	1	2	2	1	2
CO5	2	3	3	3	2	2	2	1	2	2	1	2
CO6	1	3	3	3	2	3	3	2	2	3	2	3
AVG	2.2	2.5	2.5	2.5	1.3	2.2	1.8	1.3	1.7	2.2	1.3	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP42 (Lab based on BCADSC402)**				
Course Name	**: UNIX LAB**				
Semester / Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objectives:

The objectives of this course are

1. To learn basic knowledge about architecture of Unix and different basic Commands of Unix
2. To learn how to use process management.
3. To learn basic structure and various commands of UNIX system.
4. To learn the importance of system administration tasks.
5. To learn the shell programming.
6. To learn basics of filter commands and Tools of UNIX system

COURSE CONTENTS:

- How to apply basic commands of UNIX
- How to apply filter commands.
- How to apply UNIX system administration commands
- Unix shell program based on conditional statements
- Unix shell program based on loops
- Unix shell program based on filters
- Unix shell program based on arrays

Course Outcomes (COs):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall and apply basic Unix commands and filter commands effectively.
CO2	Understand and execute Unix system administration commands.
CO3	Develop Unix shell scripts using conditional statements.
CO4	Develop Unix shell scripts using loops to solve repetitive tasks.
CO5	Analyze and write Unix shell scripts using filters for data processing.
CO6	Design and implement Unix shell scripts using arrays for complex data handling.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	2	1	2	3	2	2	2
CO2	3	2	2	2	1	2	1	2	3	2	2	2
CO3	3	3	3	3	1	2	2	3	2	2	2	2
CO4	3	3	3	3	1	2	2	3	2	2	2	2
CO5	3	3	3	3	1	3	2	3	2	3	3	2
CO6	3	3	3	3	1	3	3	3	2	3	3	2
AVG	**3**	**2.7**	**2.7**	**2.5**	**1**	**2.3**	**1.8**	**2.7**	**2.3**	**2.3**	**2.3**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC403**				
Course Name	**: SOFTWARE ENGINEERING**				
Semester / Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		3	**1**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the nature of software development and software life cycle.
2. Explain methods for capturing specifying, visualizing analyzing software requirement.
3. To know basic of testing and understanding concept of software quality assurance.
4. To understand the concept of software cost model.
5. To develop good quality software and able to maintain quality of software
6. To develop knowledge of tools available for software development.

COURSE CONTENTS

Unit I **[No. of Hours: 6]**

Introduction: Introduction to software engineering, Importance of software, evolving role of software, Software Characteristics, Software Components, Software Applications, Software Crisis, Software engineering problems, Software Development Life Cycle, Software Process.

Unit II **[No. of Hours: 8]**

Software Requirement Specification: Analysis, Principles, Water Fall Model, The Incremental Model, Prototyping, Spiral Model, Role of management in software development, Role of matrices and Measurement, Problem Analysis, Requirement specification, Monitoring and Control.

Unit III **[No. of Hours: 8]**

Software-Design: Design principles, problem partitioning, abstraction, top down and bottom up-design, Structured approach functional versus object oriented approach, design specifications and verification, Monitoring and control, Cohesiveness, coupling, Fourth generation techniques, Functional independence, Software Architecture, Transaction and Transform Mapping, Component level Design.

Unit IV **[No. of Hours: 10]**

Coding: Top-Down and Bottom Up programming, structured programming, information hiding, programming style and internal documentation. Testing principles, Levels of testing, functional testing, structural testing, test plane, test case specification, reliability assessment, software testing strategies, Verification and validation, Unit testing, Integration Testing, Alpha & Beta testing, system testing and debugging.

Unit V **[No. of Hours: 8]**

Software Reliability & Quality Assurance: Reliability issues, Reliability metrics, Reliability growth modeling, Software quality, ISO 9000 Certification for software industry, SEI capability maturity model, comparison between ISO & SEI CMM. CASE (Computer Aided Software Engineering):

CASE and its scope, CASE support in software life cycle, documentation, project management, internal interface, Reverse Software Engineering, Architecture of CASE environment.

Text Books:

TB1. Pressman, Roger S., "Software Engineering: A Practitioner's Approach Ed.Boston: McGraw Hill
TB2. Jalote, Pankaj, "Software Engineering Ed.2"New Delhi: Narosa

Reference Books:

RB1. Schaum's Series, "Software Engineering" TMH
RB2. Ghezzi Carlo and Others "Fundamentals of Software Engineering" PHI

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key concepts of SDLC, software process models, and their phases.
CO2	Explain software requirements, design principles, and testing strategies in own words.
CO3	Implement structured programming and modular design for a given problem.
CO4	Compare and contrast software process models (e.g., Waterfall vs. Agile) based on project constraints.
CO5	Assess the reliability and quality of a software system using ISO/CMM metrics.
CO6	Design and develop a prototype using CASE tools, adhering to SRS and SDLC phases.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	2	-	-	-	1	-	-
CO2	3	2	2	1	-	2	1	-	-	1	1	-
CO3	2	2	3	3	1	2	2	1	2	2	2	1
CO4	1	3	2	3	-	2	2	-	-	2	1	1
CO5	1	2	3	3	3	2	3	-	1	2	2	2
CO6	2	3	3	3	2	3	3	2	3	3	3	3
AVG	**2**	**2.2**	**2.3**	**2.3**	**1.2**	**2.2**	**2**	**0.5**	**1.2**	**1.8**	**1.5**	**1.2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAGE401**				
Course Name	**: ARTIFICIAL INTELLIGENCE**				
Semester / Year	**: 4th Semester / 2nd Year**				
	L	**T**	**P**	**C**	
	4	**0**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To impart knowledge about Artificial Intelligence.
2. To give understanding of the main abstractions and reasoning for intelligent systems.
3. To enable the students to understand the basic principles of Artificial Intelligence in various

COURSE CONTENT

Unit I **[No. of Hours: 8]**

Introduction:- Definition and meaning of artificial intelligence, A.I. techniques, pattern recognition, Level of, speech recognition representation in A.I. properties of internal representation.

Unit II **[No. of Hours: 8]**

Production System:- Different types of tracing, strategies, graph search strategies, Heuristic graph, search procedure, AND/OR graph, relationship between decomposional and compatible systems, searching Gate Tree, min-max search game playing, actual game playing.

Unit III **[No. of Hours: 8]**

Introduction to Predicate Calculus:- Predicates and Arguments, connectives, Simplifications of strategies, extracting answers from Resolution Refutation. Control strategies.

Unit IV **[No. of Hours: 8]**

Rule Based Deduction Systems: Forward and backward deduction system, resoling with AND/OR graph, computation, deduction and program synthesis, central knowledge for rules based deduct systems.

Unit V **[No. of Hours: 8]**

Structural Object Representation: Semantic networks semantic market matching deductive operations on structured objects. Architectural for A.I. Systems: Knowledge, acquisitions representation, Natural language processing.

Text Books:

TB1. Introduction to artificial Intelligence Eugene Charnik Drew MC mott

TB2. Artificial Intelligence Elaine Rice.

Reference Books:

RB1. Principal of Artificial Intelligence, Nelson, Springer-Verlag.

RB2. Artificial Intelligence Application Programming: Tim Jones, Wiley dreamtech

Course Outcomes (COs):
Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental AI concepts, techniques, and representations (e.g., heuristic search, predicate logic).
CO2	Explain the working of production systems, search strategies, and rule-based deduction systems with examples.
CO3	Implement basic AI algorithms (e.g., A* search, Minimax) to solve problems like puzzles or game scenarios.
CO4	Compare different knowledge representation methods (e.g., semantic networks vs. logic) and their suitability for given problems.
CO5	Assess the ethical and social implications of AI technologies (e.g., bias in NLP, job automation).
CO6	Design a simple AI-based system (e.g., rule-based chatbot, game-playing agent) using learned techniques.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	2	2	2	2	1	1	1	1	1	1	1	1
CO3	2	3	3	3	1	2	2	1	1	2	1	2
CO4	2	2	3	3	1	2	2	1	2	2	1	2
CO5	1	1	1	1	3	2	1	2	1	2	2	2
CO6	3	3	3	3	2	3	3	3	2	3	2	3
AVG	**2.17**	**2**	**2.17**	**2.17**	**1.5**	**2**	**1.67**	**1.5**	**1.33**	**2**	**1.33**	**1.83**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCASC401**				
Course Name	**: DIGITAL MARKETING**				
Semester / Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1 Provide students with a comprehensive understanding of digital marketing concepts, strategies, and channels.
2 Equip students with the knowledge and skills to design and optimize websites, social media campaigns, and search engine marketing initiatives.
3 Develop students' ability to analyze data from digital marketing campaigns and make data-driven decisions for campaign optimization.
4 Enable students to evaluate the performance of digital marketing campaigns and identify areas for improvement.
5 Foster the ability to create and implement integrated digital marketing campaigns to achieve specific objectives and target audiences.
6 Cultivate ethical and responsible digital marketing practices in students' professional endeavors.

COURSE CONTENTS

Unit 1: Foundations of Digital Marketing and Website Optimization [No. of Hours: 7]

Definition, scope, and importance of digital marketing, evolution and impact on businesses, key digital marketing channels and tools, core strategies and objectives, ethical and legal considerations, basics of website development and design principles, user experience (UX) and responsive design, search engine optimization (SEO) techniques for visibility, mobile optimization essentials, conversion rate optimization (CRO) basics.

Unit 2: Social Media, Content, and Search Engine Marketing [No. of Hours: 7]

Role of social media platforms in marketing, developing social media strategies, content creation for social media, social media advertising and targeting, influencer collaborations, introduction to content marketing and strategy, building online brand presence, search engine marketing (SEM) and pay-per-click (PPC), keyword research and Google Ads optimization, email marketing fundamentals, email campaign creation, email list segmentation, automation basics.

Unit 3: Analytics and Campaign Management [No. of Hours: 6]

Basics of digital marketing analytics, key performance indicators (KPIs), data analysis tools, conversion tracking, developing digital marketing campaigns, setting campaign objectives, budgeting for campaigns, audience targeting, measuring campaign performance, optimizing campaigns, reporting campaign performance.

Text Books:

TB1. "Digital Marketing: Strategy, Implementation, and Practice" by Dave Chaffey and Fiona Ellis-Chadwick
TB2. "Digital Marketing for Dummies" by Ryan Deiss and Russ Henneberry
TB3. "Social Media Marketing Workbook: How to Use Social Media for Business" by Jason McDonald
TB4. "Epic Content Marketing: How to Tell a Different Story, Break through the Clutter, and Win More Customers by Marketing Less" by Joe Pulizzi
TB5. "Google Analytics Breakthrough: From Zero to Business Impact" by Feras Alhlou, Shiraz Asif, and Eric Fettman
TB6. "The Conversion Code: Capture Internet Leads, Create Quality Appointments, Close More Sales" by Chris Smith

Reference Books:

RB1. "The Art of SEO: Mastering Search Engine Optimization" by Eric Enge, Stephen Spencer, Jessie Stricchiola, and Rand Fishkin
RB2. "Inbound Marketing: Attract, Engage, and Delight Customers Online" by Brian Halligan and Dharmesh Shah
RB3. "Email Marketing Rules: How to Wear a White Hat, Shoot Straight, and Win Hearts" by Chad S. White
RB4. "Contagious: How to Build Word of Mouth in the Digital Age" by Jonah Berger

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall core concepts of digital marketing, including key channels (SEO, SEM, social media), tools, and ethical guidelines.
CO2	Explain the role of UX design, SEO techniques, and content strategies in digital marketing campaigns.
CO3	Execute a basic PPC campaign using Google Ads and design an email marketing funnel with segmentation.
CO4	Diagnose website performance issues using analytics tools (e.g., Google Analytics) and interpret KPIs for optimization.
CO5	Assess the effectiveness of a social media campaign based on engagement metrics and ROI.
CO6	Develop a comprehensive digital marketing plan for a business, integrating SEO, social media, and paid advertising strategies.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	2	1	2	1	1	1	1
CO2	2	2	2	2	1	1	1	1	2	1	2	1
CO3	1	3	3	3	1	2	2	3	1	2	2	2
CO4	1	2	3	3	1	2	2	2	3	2	1	2
CO5	1	2	2	3	3	1	3	2	1	2	3	3
CO6	1	3	3	3	2	3	3	3	2	3	2	3
AVG	**1.5**	**2.2**	**2.3**	**2.5**	**1.7**	**1.8**	**2**	**2.2**	**1.7**	**1.8**	**1.8**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: AEC4**				
Course Name	**: COMMUNICATION SKILLS: READING AND WRITING SKILLS**				
Semester /Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

The objectives of this course are-

1. To communicate appropriately in real-life situation.
2. To use English effectively for study and communicative purpose for successful career.
3. To develop and integrate the use of four language skills- Reading and Writing in his/her whole life.
4. To understand different types of barriers and kinds of communication.
5. Learn the skills to face interview, making a speech, presentation etc.

Course Contents

Unit 1: Introduction: Types and modes of Communication

Barrier to Communication, Kinds of communication: intrapersonal, personal, group and mass, Verbal and non-Verbal communication

Unit 2: Reading Skills

Skimming, Scanning, Summary, Paraphrasing, Comprehension

Unit 3: Writing Skills: Social and Official Correspondence

Complaints and replies, Letter to the editors, Standard business letter, Email drafting and etiquettes, Preparing agenda and minutes for meetings, Job application, Cover letters, Bio-data, CV and Resume

Reference Books:

1. Dangwal, Surekha. The Art Effective Communication. Delhi: Macmillan
2. Prasad, P. The Functional Aspects of Communication skills, Delhi
3. Sen, Leena. Communication Skills, Prentice hall of India, New Delhi
4. McCarty, Michel. English Vocabulary in Use, Cambridge University Press.
5. Communication Skill by Sanjay Kumar & Pushp Lata, Oxford University Press
6. An Introduction to Professional English and Soft Skills by B.K. Das, Cambridge University.

Course outcomes (COs):

Upon successful completion of the course a student will be able -

CO1	To memorize the functions of communication and related topics.
CO2	To improve communication skills to communicate within the society.
CO3	To implement writing and reading as skills.
CO4	To organize vocabulary and improve accuracy in grammar.
CO5	To select positive attitudes for English Communication.
CO6	To design formal letters, CV, interview, resume and cover letters etc. for successful career skills.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	2	1	1	1	1	1	3	2
CO2	1	3	1	1	2	1	1	1	1	1	3	2
CO3	1	2	1	1	1	2	1	1	1	2	3	2
CO4	1	2	1	1	1	2	1	1	1	2	3	2
CO5	1	2	1	1	3	1	1	1	1	2	3	2
CO6	1	3	2	2	2	1	2	2	1	2	3	3
AVG	**1**	**2.5**	**1.17**	**1.17**	**1.83**	**1.33**	**1.17**	**1.17**	**1**	**1.67**	**3**	**2.17**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: CITVC401**				
Course Name	**: CHALLENGES IN PROGRAMMING**				
Semester /Year	**: 4th Semester / 2nd Year**				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

The objectives of this course are-

1. Understand the software development life cycle and its coding phase challenges.
2. Apply techniques for code optimization and efficiency to improve performance.
3. Demonstrate effective debugging and troubleshooting skills.
4. Implement secure coding practices and error handling mechanisms.
5. Utilize version control and collaborative coding strategies.
6. Analyze legacy code and propose refactoring solutions.
7. Evaluate code quality, documentation, and external dependencies.
8. Create efficient, secure, and well-documented code to meet project requirements.

COURSE CONTENTS

Unit 1: Software Development and Code Quality **[No. of Hours: 6]**

Overview of Software Development Life Cycle (SDLC) and common coding challenges, Importance of code quality and maintainability, Introduction to version control (e.g., Git) and collaborative coding (branching, merging), Basics of code documentation and meaningful commenting.

Unit 2: Code Optimization, Debugging, and Error Handling **[No. of Hours: 7]**

Techniques for optimizing code (speed, memory) and algorithmic efficiency, Identifying and resolving performance bottlenecks, Debugging strategies and tools (e.g., breakpoints, logging), Common coding errors and prevention techniques, Error handling, exception management, and writing robust code.

Unit 3: Security, Legacy Code, and Project Management **[No. of Hours: 7]**

Basics of software security and common vulnerabilities (e.g., SQL injection, XSS), Secure coding practices and graceful degradation, Challenges of legacy code, refactoring, and modernization techniques, Agile project management, handling deadlines, and adapting to changing requirements.

Text Books:

TB1. Clean Architecture: A Craftsman's Guide to Software Structure and Design by Robert C. Martin
TB2. Code Complete: A Practical Handbook of Software Construction by Steve McConnell
TB3. Working Effectively with Legacy Code by Michael C. Feathers

Reference Books/ Online Resources

RB1. Refactoring: Improving the Design of Existing Code by Martin Fowler
RB2. Design Patterns: Elements of Reusable Object-Oriented Software by Erich Gamma
RB3. Test-Driven Development: By Example by Kent Beck

Course outcomes (COs):

Upon successful completion of the course a student will be able –

CO1	Recall key phases of SDLC, version control concepts (Git), and security vulnerabilities (SQLi, XSS).
CO2	Explain code optimization techniques, debugging strategies, and Agile principles.
CO3	Use Git for collaborative coding, debug tools (breakpoints, logging), and secure coding practices.
CO4	Identify performance bottlenecks in code and refactor legacy systems for maintainability.
CO5	Assess code quality (readability, efficiency) and ethical implications of security flaws.
CO6	Design a robust, optimized software module with documentation, adhering to SDLC and Agile.

CO-PO-PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2	1	1	1	1	1	1	1
CO2	2	3	2	2	1	2	2	1	1	2	1	1
CO3	2	2	3	2	2	2	3	2	3	2	2	2
CO4	1	3	3	3	1	3	2	1	2	3	1	2
CO5	1	2	2	2	3	2	2	1	1	3	2	2
CO6	2	3	3	3	2	3	3	3	2	3	3	3
AVG	**1.8**	**2.3**	**2.3**	**2.2**	**1.8**	**2.2**	**2.2**	**1.5**	**1.7**	**2.3**	**1.7**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

5th Semester

Course code	**: BCADSC501**				
Course Name	**: PYTHON PROGRAMMING**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Master the core of writing Python scripts
2. Understand decision-making and functions in python
3. Interpret Object-oriented programming features in python
4. Gain knowledge of data structures in python
5. Explore file handling and database operations in python

COURSE CONTENTS

Unit I **[No. of Hours: 10]**

Introduction: History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator, Conditional Statements: If, If- else, Nested if-else, Looping: For, While, Nested loops, Control Statements: Break, Continue, Pass

Unit II **[No. of Hours: 11]**

String: Accessing Strings, Basic Operations, String slices, Function and Methods. **Lists**: Introduction, accessing list, Operations, working with lists, Function and Methods, sorting, searching. **Tuple**: Introduction, accessing tuples, Operations, Working, Functions and Methods **Sets**: Introduction, Accessing sets, Operations, Working, Functions and Methods. **Dictionaries**: Introduction, accessing values in dictionaries, Working with dictionaries, Properties, Functions. **Sets:** Introduction, accessing values in sets, Working with dictionaries, Properties, Functions

Unit III **[No. of Hours: 7]**

Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables, Python Lambda, recursion. Modules: Importing module, Math module, Random module, Packages, Composition

Unit IV **[No. of Hours: 7]**

Input-Output: Printing on screen, reading data from keyboard, **File Handling:** Opening and closing file, Reading and writing files. **Database handling using SQLite3. Exception Handling:** Exception, Except clause, Try, finally clause, User Defined Exceptions

Unit V **[No. of Hours: 5]**

OOPs concept: Class and object, Attributes, Inheritance, Overloading, Overriding, Data hiding.

Text Books:

TB1. Budd T A, "Exploring Python", McGraw-Hill Education
TB2. Mark Lutz, "Learning Python", O'Reilly.
TB3. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson

Reference Books:

RB1. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning
RB2. Allen Downey, "Think Python: How to Think Like a Computer Scientist", O'Reilly
RB3. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press
RB4. Joel Grus, "Data Science from Scratch", O'Reilly
RB5. Tony Gaddis, "Starting out with Python", Pearson

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Knowledge and remember the programming constructs used in python.
CO2	Understanding the facts behind the sequences, functions, modules, files, database and object oriented etc. used in Python
CO3	Apply data structure primitives like strings, lists, tuples, sets and dictionaries on various types of data with or without using functions, object-oriented concepts to the programs in Python etc.
CO4	Distinguish and analyze basic constructs of Python and how constructs can be used all together.
CO5	Evaluate the programming constructs of Python to provide verdict on findings.
CO6	Create python programs using various programming constructs of Python.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	1	-	2	2	1	-	-
CO3	3	3	3	2	1	1	1	3	3	1	1	1
CO4	2	3	3	3	-	2	1	2	1	2	-	1
CO5	1	3	2	3	2	1	2	2	1	2	2	2
CO6	2	3	3	3	3	3	3	3	3	3	3	3
AVG	**2.33**	**2.5**	**2.2**	**2**	**1.5**	**1.33**	**1.5**	**2.17**	**1.67**	**1.83**	**1.5**	**1.5**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP51 (Lab based on BCADSC501)**				
Course Name	**: PYTHON PROGRAMMING LAB**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Basic programming constructs and functions in python.
2. Understand the applicability of data structures like lists, tuples, sets and dictionaries inpython applications.
3. Use object-oriented programming features of python to develop applications.
4. Learn how to use exception handling in applications for error handling.
5. Database and file based programming

COURSE CONTENTS

- Working with Jupyter notebook.
- Programs based on loops and conditional statements.
- Programs based on string manipulations.
- Programs based on List.
- Programs based on tuples.
- Programs based on sets.
- Programs based on dictionary.
- Working with user defined functions.
- Working with lambda, map, filter and reduce functions.
- Programs based on recursion.
- Programs for file handling in Python.
- Programs for Sorting and searching.
- Database handling in Python using SQLite3.
- Working with in built and user defined modules,
- Working with Object Oriented Programming in Python.

Course Outcomes (COs):
Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Recall Python syntax, data types, operators, and control structures to explain fundamental programming concepts.
CO2	Interpret string operations, list/tuple manipulations, and dictionary methods to demonstrate data structure functionalities.
CO3	Implement functions, modules, and file handling techniques to solve computational problems.
CO4	Diagnose errors in Python programs using exception handling and debugging techniques.
CO5	Compare OOP approaches (inheritance, polymorphism) to select optimal solutions for given problems.
CO6	Design and develop integrated Python applications using databases and multiple programming paradigms.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	3	2	2	2	1	1	1	1	1	2	1	1
CO3	3	3	3	3	2	2	2	2	2	2	2	2
CO4	2	3	3	3	2	2	2	2	1	2	2	2
CO5	2	3	3	3	3	2	2	2	1	2	2	2
CO6	3	3	3	3	3	3	3	3	3	3	3	3
AVG	**2.7**	**2.5**	**2.5**	**2.5**	**2**	**2**	**1.8**	**1.8**	**1.5**	**2.2**	**1.8**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSC502**				
Course Name	**: C# DOT NET**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Demonstrate proficiency in C# syntax, .NET architecture, and OOP principles to build structured applications.
2. Develop functional console and Windows Forms applications using variables, operators, and file I/O operations.
3. Debug and optimize C# programs by analyzing logic errors, exceptions, and LINQ queries.
4. Evaluate and implement efficient data structures (e.g., Lists, Dictionaries) and OOP design patterns.
5. Design and deploy a data-driven desktop application with SQL Server integration using Entity Framework Core.

COURSE CONTENTS

Unit 1: Introduction to C# and .NET **[No. of Hours: 8]**

Overview of .NET Framework and .NET Core, C# basics including variables, data types, operators, and control structures, console input/output operations, hands-on creation of a simple console application like a calculator or greeting program.

Unit 2: Object-Oriented Programming in C# **[No. of Hours: 8]**

Object-oriented programming concepts such as classes, objects, methods, and properties, encapsulation, inheritance, and polymorphism with access modifiers, constructors and destructors for object management.

Unit 3: Working with Data and Collections **[No. of Hours: 8]**

Arrays, Lists, Dictionaries, and basic LINQ operations, exception handling with try-catch and custom exceptions, file input/output for reading and writing text or CSV files.

Unit 4: Introduction to Windows Forms **[No. of Hours: 8]**

Windows Forms basics for creating desktop applications, designing user interfaces with controls like buttons, textboxes, and labels, event handling for user interactions.

Unit 5: Advanced Topics and Project **[No. of Hours: 8]**

Database integration with SQL Server using Entity Framework Core, building basic data-driven applications, deploying .NET applications locally.

Text Books:

TB1. A Guide to the Project Management Body of Knowledge (PMBOK), Project Management Institute,PA
TB2. Harold Kerzner, Frank P. Saladis, Project Management Workbook and PMP/CAPM Exam Study Guide, Wiley Publishers
TB3. Addison Wesley –C# Developers Guide to ASP.Net Wiley," Beginning Visual C# ",Wrox

Reference Books:

RB1. C#.Net Developers Guide- Greg Hack, Jason Werry, Saurabh Nandu. (SyngRess)
RB2. Wrox Press Professional C# – Simon Robinson, Jay Glynn

Course outcomes (COs):
Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall core concepts of C# syntax, .NET architecture, and OOP principles.
CO2	Explain the purpose of .NET components and interpret code blocks involving control structures, exceptions, and collections.
CO3	Develop functional console applications using variables, operators, and file I/O operations.
CO4	Diagnose and debug issues in C# programs by evaluating logic errors, exception handling, and LINQ query results.
CO5	Assess the efficiency of different data structures and justify design choices in OOP.
CO6	Design and deploy a data-driven desktop application (Windows Forms) with SQL Server integration, applying end-to-end development principles.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	1	2	1	2	1	1
CO2	3	2	2	2	1	2	1	2	2	2	1	1
CO3	3	2	3	3	1	2	2	2	2	2	1	2
CO4	2	3	3	3	1	2	2	2	2	2	2	2
CO5	2	3	3	3	2	2	2	2	3	2	2	2
CO6	2	3	3	3	2	3	3	3	3	3	2	3
AVG	2.5	2.3	2.7	2.5	1.3	2.2	1.8	2.2	2.2	2.2	1.5	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP52 (Lab based on BCADSC502)**				
Course Name	**: C# DOT NET LAB**				
Semester / Year	**: 5th Semester / 3rd Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Write and execute basic C# programs using fundamental syntax, data types, and control structures.
2. Implement object-oriented programming concepts like classes, inheritance, and polymorphism in practical applications.
3. Debug and optimize C# code using exception handling and error-management techniques.
4. Develop interactive Windows Forms or WPF applications with event-driven functionalities.
5. Connect C# applications to databases using ADO.NET or Entity Framework for data storage and retrieval.

Course Outcomes (COs):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Demonstrate C# syntax, data types, operators, and control structures to explain basic programming constructs.
CO2	Implement object-oriented programming concepts (classes, inheritance, polymorphism) to develop C# applications.
CO3	Debug C# programs using exception handling techniques and analyze code for optimization.
CO4	Develop Windows Forms or WPF applications with event-driven programming and user interface components.
CO5	Assess database connectivity solutions using ADO.NET/Entity Framework to manage data operations in C# applications.
CO6	Design and implement an integrated C# application combining OOP, GUI development, and database connectivity to solve real-world problems.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	1	1	1	2	1	1
CO2	3	2	3	2	1	2	1	2	1	2	2	2
CO3	2	3	3	3	2	2	2	2	1	2	2	2
CO4	2	3	3	3	2	3	3	3	1	3	3	3
CO5	2	3	3	3	2	2	3	3	3	2	2	3
CO6	2	3	3	3	3	3	3	3	3	3	3	3
AVG	**2.3**	**2.5**	**2.8**	**2.5**	**1.8**	**2.3**	**2.2**	**2.3**	**1.7**	**2.3**	**2.2**	**2.3**

Course code	**: BCADSC503**				
Course Name	**: INTRODUCTION TO MACHINE LEARNING**				
Semester / Year	**: 5th Semester / 3rd Year**				
	L	**T**	**P**	**C**	
	3	**1**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the fundamental concepts of machine learning, including supervised and unsupervised learning, data preprocessing, and key mathematical foundations.
2. Apply supervised learning techniques such as linear regression, logistic regression, and regularization while evaluating models using appropriate metrics.
3. Implement unsupervised learning methods like K-means clustering and PCA, and analyze their real-world applications and challenges.
4. Explore advanced ML concepts including decision trees, neural networks, and ethical considerations in AI, while gaining an introductory understanding of reinforcement learning.
5. Develop skills in model evaluation, hyperparameter tuning, and feature selection, while staying informed about emerging trends in machine learning.

COURSE CONTENTS

Unit 1: Basics of Machine Learning **[No. of Hours: 8]**

Definition of machine learning, types of supervised and unsupervised learning, real-world applications, importance of data in ML, basics of data preprocessing, introduction to probability and statistics, overview of linear algebra for ML.

Unit 2: Supervised Learning Fundamentals **[No. of Hours: 8]**

Supervised learning, difference between regression and classification, linear regression, concept of cost function, logistic regression for classification, understanding overfitting, basics of regularization, evaluation metrics like accuracy and precision.

Unit 3: Unsupervised Learning Basics **[No. of Hours: 8]**

Unsupervised learning, clustering with K-means, basics of dimensionality reduction, Principal Component Analysis (PCA), applications of clustering and PCA, challenges in evaluating unsupervised models.

Unit 4: Introduction to Advanced ML Concepts **[No. of Hours: 8]**

Decision trees, basics of ensemble methods like random forests, introduction to neural networks, perceptrons, activation functions, overview of reinforcement learning, ethical issues in ML like bias and fairness.

Unit 5: Evaluating and Improving Models **[No. of Hours: 8]**

Cross-validation, k-fold cross-validation, hyperparameter tuning, introduction to grid search, model selection, basics of feature selection, emerging trends like explainable AI.

Text Book:

TB1. "Understanding Machine Learning: From Theory to Algorithms" by Shai Shalev-Shwartz and Shai Ben-David
TB2. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
TB3. "Machine Learning for Dummies" by John Paul Mueller and Luca Massaron

Reference Books:

RB1. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
RB2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
RB3. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
RB4. "Introduction to Machine Learning" by Ethem Alpaydin
RB5. "Machine Learning: The Art and Science of Algorithms that Make Sense of Data" by Peter Flach
RB6. "Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall the definitions and key concepts related to Machine Learning and identify different types of Machine Learning algorithms and their applications.
CO2	Explain the principles and techniques of supervised and unsupervised learning and demonstrate an understanding of evaluation metrics and model selection techniques in Machine Learning.
CO3	Apply data preprocessing and cleaning techniques to prepare data for Machine Learning algorithms and implement & apply various Machine Learning algorithms to solve classification and regression problems.
CO4	Analyze the performance of Machine Learning models using evaluation metrics and interpret the results and evaluate the impact of different hyperparameter settings on model performance.
CO5	Critically evaluate the strengths and weaknesses of different Machine Learning algorithms for specific tasks and assess the ethical implications and considerations of using Machine Learning algorithms in real-world applications.
CO6	Design and create Machine Learning models to solve complex problems and develop innovative solutions by combining different Machine Learning techniques and algorithms.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1	1	1	1	1	1	1
CO2	2	2	3	2	1	2	2	2	1	1	1	2
CO3	2	2	3	2	1	2	2	2	1	1	1	2
CO4	2	1	2	1	1	2	2	2	1	1	1	1
CO5	1	1	2	2	2	2	2	2	1	1	2	2
CO6	2	2	2	3	2	3	3	3	1	1	2	3
AVG	**1.8**	**1.6**	**2.4**	**1.8**	**1.4**	**2**	**2**	**2**	**1**	**1**	**1.4**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE504A**				
Course Name	**: STATISTICS/MOOC ON STATISTICS**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. To study methods of collection, classification, tabulation of data.
2. To apply various statistical methods and analyses the data
3. To find correlation between the data.
4. To study probability and probability distribution to solve various real life problems
5. To test hypothesis using various statistical test.

COURSE CONTENTS

UNIT 1: Data & Its Diagrammatic Representation **[No. of Hours: 8]**

Definition of Statistics, Data, Primary data & secondary data, classification of data, tabulation of data, individual series, Discrete frequency Distribution, continuous frequency distribution, Exclusive and inclusive continuous series, Diagrammatic representation of data, Tabular form, 1D (All Bar Diagrams), Histogram, Frequency polygon, frequency curve, Ogive.

UNIT 2: Measure of Central Tendency & Dispersion **[No. of Hours: 8]**

Mean (Arithmetic Mean, Weighted Mean, Harmonic Mean, Geometric Mean), Median, Mode, Histogram & Mode, Relationship between mean, median, mode. Definition of dispersion, Range, Quartile deviation & its coefficient, Inter Quartile deviation, Mean deviation & its coefficient, Standard deviation.

UNIT 3: Correlation & Regression Analysis **[No. of Hours: 8]**

Correlation definition, types of correlation, Karl Pearson coefficient of correlation, Spearman coefficient of correlation, repeated rank. **Regression Analysis** Regression lines, Regression line of Yon X & X on Y, Regression coefficient, Relationship between correlation & regression coefficient.

UNIT 4: Probability & Probability Distributions **[No. of Hours: 8]**

probability & probability distribution: probability, Sample space & events, types of events, conditional probability, Bayes theorem, Mathematical expectation

UNIT 5: Sampling, Hypothesis Testing & Statistical Test **[No. of Hours: 8]**

Sampling & its type, Probability & Non probability sampling, Hypothesis, Null hypothesis, Alternative hypothesis, Type I & Type II Errors, Statistical **Test:** Parametric test & non parametric test, F test, T test, ANOVA -1, ANOVA 2, Chi square test as a goodness of fit, Chi square test as test of independence.

Text Books:

TB1. Gerald Keller : Managerial Statistics.

Reference Books:

RB1. Richard Levin & David Rubin : Statistics for management, Prentice Hall.

RB2. Anderson, Sweeny & Williams: Statistics for Business and Economics, South W

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	To gain knowledge of statistical method like Average, Correlation, Regression, dispersion probability and probability distribution
CO2	To understand statistical method like Average, Correlation, Regression, dispersion probability and probability distribution
CO3	To apply statistical method and probability distribution
CO4	To analyze various statistical method and probability distribution
CO5	To apply statistical method probability distribution and statistical test to test the hypothesis
CO6	To create new statistical method probability distribution and statistical test

CO –PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	2	1	1	2	2	1	1
CO2	3	2	3	2	1	2	2	1	3	2	2	2
CO3	3	3	3	3	2	2	3	2	3	2	2	3
CO4	3	3	3	3	2	2	3	2	3	2	2	3
CO5	2	3	2	3	3	2	3	2	2	2	3	3
CO6	1	2	1	2	1	3	2	1	1	3	1	2
AVG	2.33	2.33	2.33	2.33	1.67	2.17	2.33	1.5	2.33	2.17	1.83	2.33

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE504B**				
Course Name	**: OPERATIONS RESEARCH/ MOOC ON OPERATIONS RESEARCH**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To impart knowledge in concepts and tools of Operations Research
2. To understand mathematical models used in Operations Research
3. To apply these techniques constructively to make effective business decisions.
4. To be capable of analysing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.
5. To enable the student to understand and analyse managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively.

COURSE CONTENTS

Unit 1 **[No. of Hours: 6]**

Introduction to OR: Meaning and scope of O.R, Definition of O.R, LPP (Linear Programming Problem). Formulation of LPP, graphical solution of LPP- Problems

Unit 2 **[No. of Hours: 8]**

LPP: IBFS, Basic and Non-basic variable, Slack variable, Surplus variable and Artificial variable, Simplex method, Big M, two phase simplex methods and problems

Unit 3 **[No. of Hours: 10]**

Transportation problem: Definition, feasible solution by North-West corner rule, LCM, VAM, Optimal solution through MODI & stepping stone method for balanced and unbalanced transportation problem.

Assignment problem: Meaning of assignment problem, unbalanced assignment problem, travelling salesman problem, Hungarian method for optimal solution.

Unit 4 **[No. of Hours: 8]**

Game Theory: Concept of game; Two-person zero-sum game; Pure and Mixed Strategy Games; Saddle Point

Unit 5 **[No. of Hours: 8]**

Sequencing problem: Optimal sequencing of N Jobs on 2 and 3 machines.

Project Management: Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control

Text Books:

TB1. Apte - Operation Research and Quantitative Techniques (Excel Books)
TB2. S Kalawathy - Operation Research

Reference Books:

RB1. Natarajan - Operation Research(Pearson)
RB2. Singh & Kumar - Operation Research(UDH Publisher)

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recognize LPP as a tool used to construct a mathematical model of a real-world problem which has many alternative solutions.
CO2	Interpret simplex method and duality to solve linear programming problems.
CO3	Solve transportation and assignment problems. Determine optimal strategy for Minimization of Cost of shipping of products from source to Destination/ Maximization of profits of shipping products using various methods.
CO4	Simplify and optimize the allocation of resources to Demand points in the best possible way using various techniques and minimize the cost or time of completion of number of jobs by number of persons.
CO5	Employ the principles of game theory in practical situations.
CO6	Formulate Network models for service and manufacturing systems and learn about project scheduling by PERT/CPM.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	1	2	2	1	1	2	1	2
CO2	3	3	3	3	1	2	3	2	2	2	2	2
CO3	3	3	3	3	2	2	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3	3	3	2	2	3
CO5	2	2	2	2	3	1	2	1	1	1	2	2
CO6	3	3	3	3	2	3	3	2	2	3	2	3
AVG	2.83	2.67	2.83	2.83	1.83	2	2.67	2	2	2	1.83	2.5

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAGE501**				
Course Name	**: ENTERPRISE RESOURCE PLANNING**				
Semester / Year	**: 5th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To learn the need and evolution of ERP Systems and related technologies.
2. To learn ERP benefits and classification and implementation of ERP Life Cycle
3. To learn Analytical Hierarchy Process & its applications and ERP implementation approaches and its strategies.
4. To learn factors affecting ERP success and effectiveness.
5. To learn extend ERP and its learning and emerging issues.

COURSE CONTENTS

Unit-I **[No. of Hours: 10]**

Enterprise-wide information system, Custom built and packaged approaches, Needs and Evolution of ERP Systems, Common myths and evolving realities, ERP and Related Technologies: Business Process Reengineering and Information Technology, Supply Chain Management, Data Warehousing, Data Mining and OLAP, ERP Drivers, Decision support system

Unit-II **[No. of Hours: 6]**

ERP Domain, ERP Benefits classification, Present global and Indian market scenario, milestones and pitfalls, Forecast, Market players and profiles, Evaluation criterion for ERP product.

Unit-III **[No. of Hours: 6]**

ERP Life Cycle: Adoption Decision, Acquisition, Implementation, Use & Maintenance, Evolution and Retirement phases, ERP Modules

Unit- IV **[No. of Hours: 10]**

Framework for evaluating ERP acquisition, Analytical Hierarchy Processes (AHP), Applications of AHP in Evaluating ERP, Selection of Weights, Role of consultants, vendors and users in ERP implementation; Implementation vendor's evaluation criterion, ERP Implementation approaches and methodology, ERP Implementation strategies, ERP Customization,

Unit- V **[No. of Hours: 8]**

Critical success and failure factors for implementation, Hidden costs, Useful guidelines for ERP Implementations.

Text Books:

TB1. Enterprise Resource Planning, Alexis Leon

TB2. ERP Concepts & Planning, V.K. Garg & N.K. Venkita Krishnan

Reference Books:

RB3. ERP Ware: ERP Implementation Framework, V.K. Garg &N.K. Venkita Krishnan

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Defining basic use of enterprise software and its role in integrating business functions, reengineered business processes, phases of ERP implementation life cycle, domains of ERPs, implementation cost etc.
CO2	Understanding the work done during the ERP implementation life cycle.
CO3	Illustrate the Analytical Hierarchy Processes (AHP) for the selection of ERP system. Apply the customization to ERP system as per user's requirement.
CO4	Analyse the role of consultant, vendors and users in ERP implementation.
CO5	Evaluate critical success and failure factors for implementation, Hidden cost during ERP implementation.
CO6	Formulate methodology for the implementation of ERP system.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	3	2	2	2	2	1	2	2	2
CO2	3	2	3	2	2	2	2	2	2	2	2	2
CO3	3	2	3	2	2	2	2	2	2	2	2	2
CO4	2	3	3	3	2	2	2	2	2	2	2	2
CO5	2	3	2	3	2	2	2	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	2	2	2	2
AVG	**2.33**	**2.5**	**2.67**	**2.5**	**2**	**2**	**2**	**2**	**1.83**	**2**	**2**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCASM5**			
Course Name	**: SEMINAR**			
Semester / Year	**: 5th Semester / 3rd Year**			
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well-organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recite and speak cogently with or without notes on the topic using audio-visual aids.
CO2	Utilize technical resources.
CO3	Acquire the confidence in presenting the topic.
CO4	Analyze technically relevant current topics on computer science/information technology/research.
CO5	Create audience-centered presentations.
CO6	Create technical documents and give oral presentations related to the work completed.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	1	1	1	1	1	3	3
CO2	3	1	2	2	1	3	1	1	2	3	1	1
CO3	1	1	1	1	2	1	1	1	1	1	3	3
CO4	3	2	3	3	1	2	1	1	1	2	2	1
CO5	1	3	1	1	2	1	2	1	1	1	3	2
CO6	2	3	2	2	1	1	3	1	3	1	3	2
AVG	1.8	2	1.7	1.7	1.5	1.5	1.5	1	1.5	1.5	2.5	2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

6th Semester

Course code	**: BCAPR6**				
Course Name	**: PROJECT**				
Semester / Year	**: 6th Semester / 3rd Year**				
		L	**T**	**P**	**C**
		0	**0**	**24**	**12**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop working expertise of solving complex computing problems through project-based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Identify the problem and describing it.
CO2	Understand the requirements of the chosen project.
CO3	Apply the collected requirements to define the describe the project in a systematic and comprehensive approach.
CO4	Analyze the technical aspects of the chosen project to find the possible solutions for development of the project.
CO5	Evaluate the effective reports and documentation for all project related activities and solutions.
CO6	Create plan for the project development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	1	1	1	1
CO2	2	3	2	2	1	1	3	1	1	1	1	1
CO3	2	3	3	3	1	1	3	1	2	1	1	2
CO4	3	3	3	3	1	2	2	1	2	2	1	2
CO5	1	2	2	2	3	1	3	1	3	1	2	2
CO6	1	2	2	2	1	1	3	2	1	1	1	3
AVG	**1.8**	**2.8**	**2.3**	**2.3**	**1.3**	**1.2**	**2.7**	**1.2**	**1.7**	**1.2**	**1.2**	**1.7**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

7th Semester

Course code	**: BCADSC701**				
Course Name	**: DATA SCIENCE USING PYTHON**				
Semester / Year	**: 7th Semester / 4th Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understating the concept of Data Science
2. Using the data science using Python
3. Understanding the use of NumPy in data science and how it is different from Python List
4. To understand the dataframe, reading csv, tsv file and working on it.
5. Handling the missing value and data cleansing
6. Understanding the concept of visualize the numbers in graphs using the Python libraries Metplotlib and Seaborn

COURSE CONTENTS

Unit I **[No. of Hours: 12]**

NumPy: Introduction, NumPy Array, NumPy Array Size, NumPy Array Shape, NumPy Mathematical Functions, NumPy Trigonometric Functions, NumPy Random, NumPy String Operations

Unit II **[No. of Hours: 12]**

Pandas: Pandas Series, Pandas DataFrame, Pandas Read_csv, Pandas Write csv File, Data Cleansing, Pandas Handling Missing Values, Pandas concat(), Pandas join(), Pandas append(), Pandas GroupBy

Unit III **[No. of Hours: 10]**

Metplotlib: Matplotlib Line Plot, Matplotlib Histogram, Matplotlib Bar Chart, Matplotlib Pie Chart, Matplotlib Scatter Plot, Matplotlib Subplot, Matplotlib Save Figure, Matplotlib Image Show

Unit IV **[No. of Hours: 6]**

Seaborn: Introduction, Seaborn Line Plot, Seaborn Histogram, Seaborn Barplot

Text Books

TB3. Pandas for everyone, Python Data Analysis by Daniel Y. Chen, Pearson publication
TB4. Laura Igual, Santi Seguí, "Introduction to Data Science - A Python Approach to Concepts,

Reference book:

RB3. Techniques and Applications", Springer

Abhishek Kashish Vaishali

RB4. Wes McKinney, "Python for Data Analysis", O'Reilly
RB5. Luca Massaron, John Paul Mueller, "Python for Data Science for Dummies"

Course Outcomes (COs):
Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
GO1	Recall the syntax and functions of NumPy and Pandas for array and dataframe manipulations.
CO2	Explain the role of data cleansing techniques (e.g., handling missing values) in preparing datasets for analysis.
CO3	Implement Python libraries (NumPy, Pandas) to perform mathematical operations and data wrangling on real-world datasets.
CO4	Compare and contrast visualization tools (Matplotlib vs. Seaborn) to select the optimal method for a given dataset.
CO5	Assess the effectiveness of different data grouping strategies (Pandas GroupBy) to derive actionable insights.
CO6	Design an end-to-end data analysis project by integrating NumPy, Pandas, and visualization libraries to solve a business problem.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	2	1	1	1	1	1	1
CO2	2	2	3	2	2	1	1	1	3	1	1	1
CO3	3	3	3	3	1	2	2	2	3	2	2	2
CO4	1	3	2	3	1	3	2	2	1	2	3	2
CO5	1	3	3	3	2	1	3	2	2	1	2	3
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	**2**	**2.5**	**2.7**	**2.5**	**1.7**	**2**	**2**	**1.8**	**2**	**1.7**	**2**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP71 (Lab based on BCADSC701)**				
Course Name	**: DATA SCIENCE LAB**				
Semester / Year	**: 7th Semester / 4th Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Using the data science using Python
2. Understanding the use of NumPy in data science
3. To understand the dataframe, reading csv, tsv file and working on it.
4. Handling the missing value and data cleansing
5. Understanding the concept of visualize the numbers in graphs using the Python libraries Metplotlib and Seaborn

COURSE CONTENTS

- Programs based using NumPy.
- Programs based on using series and dataframe using Pandas.
- Reading CSV files in Panadas
- Handling missing values in Panadas
- Using concat(), join(), append() and groupby in Panadas
- Plotting line plot, histogram, bar chart, pie chart, scatter plot, subplot etc. using Matplotlib and saving the figure.
- Plotting line plot, histogram, bar plot, scatter plot, heatmap, etc. using Seaborn

Course Outcomes (COs):
Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Recall the syntax and functions of NumPy, Pandas, Matplotlib, and Seaborn for data manipulation
CO2	Explain the purpose of key operations (e.g., GroupBy in Pandas, trigonometric functions in NumPy) and interpret their outputs.
CO3	Implement data cleaning, transformation, and visualization techniques using Python libraries to solve structured problems.
CO4	Diagnose data quality issues (e.g., missing values, outliers) and select appropriate methods to address them.
CO5	Compare the effectiveness of different visualization types (e.g., histograms vs. box plots) for a given dataset.
CO6	Design an end-to-end data analysis project by integrating NumPy, Pandas, and visualization tools to derive actionable insights.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	1	-	-	-	-	-	-
CO2	2	1	3	1	-	-	-	-	1	-	-	-
CO3	3	2	3	2	1	2	1	1	2	1	1	1
CO4	-	3	2	3	1	-	2	-	2	-	-	1
CO5	-	3	1	2	2	1	1	1	-	1	1	1
CO6	-	3	2	3	2	2	3	2	1	2	2	3
AVG	**2**	**2**	**2.2**	**1.8**	**1**	**1.2**	**1.4**	**1**	**1.2**	**1**	**1**	**1.2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE702A**				
Course Name	**: RESEARCH METHODOLOGY AND PUBLICATION ETHICS**				
Semester / Year	**: 7th Semester / 4th Year**				
	L	**T**	**P**	**C**	
	3	**1**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the research process and its significance in computer applications.
2. Familiarize students with various research methods and designs.
3. Develop skills to design research studies and formulate research questions.
4. Gain proficiency in data collection, analysis, and interpretation.
5. Enhance critical evaluation and interpretation of research literature.
6. Develop effective research reporting and presentation skills.
7. Foster ethical conduct and responsible research practices.
8. Stimulate creativity in proposing innovative research directions.

Course Contents

Unit 1: Foundations of Research and Ethics **[No. of Hours: 8]**

Definition and Scope: Importance of research in computer science, types of research (basic, applied, experimental).

Research Ethics: Ethical considerations in research, responsible conduct, research misconduct, and ethical violations.

Ethical Guidelines: Overview of codes of conduct (e.g., ACM Code of Ethics), role of professional organizations in computer science.

Social Implications: Impact of research on society, ethical issues in emerging areas (e.g., AI, data science, cybersecurity).

Components of a Research Study: Key elements and structure of a research project.

Unit 2: Research Design and Data Collection **[No. of Hours: 10]**

Research Problem and Design: Identifying and formulating research problems, objectives, questions/hypotheses, variables, and operationalization.

Research Designs: Exploratory, descriptive, experimental designs, and sampling techniques (including sample size determination).

Data Collection Methods: Primary and secondary data, quantitative methods (surveys, experiments, observation), qualitative methods (interviews, focus groups, case studies).

Data Quality: Validity, reliability, questionnaire design, and survey construction.

Ethical Data Handling: Informed consent, ethical review boards, data privacy, and handling human participants.

Unit 3: Data Analysis and Interpretation **[No. of Hours: 8]**

Quantitative Analysis: Descriptive and inferential statistics, use of statistical tools (SPSS, R, Excel).

Qualitative Analysis: Content analysis, thematic analysis.

Interpreting Findings: Drawing conclusions, synthesizing results, and identifying research gaps.
Critical Evaluation: Reviewing research literature, assessing research quality, and proposing future research directions.

Unit 4: Academic Writing and Publication **[No. of Hours: 8]**
Research Paper Structure: Components (title, abstract, introduction, methodology, results, conclusion), literature review, and referencing.
Writing and Formatting: Clear and concise writing, citation styles (APA, IEEE, MLA), formatting research papers and proposals.
Publication Process: Types of publications (conference papers, journal articles), steps in the publication process.
Responsible Authorship: Authorship guidelines, collaboration, authorship order, handling disputes, conflicts of interest, and funding disclosure.

Unit 5: Research Integrity and Professional Development **[No. of Hours: 6]**
Plagiarism and Intellectual Property: Understanding plagiarism, avoidance techniques (paraphrasing, citing), intellectual property, copyrights, and patents.
Research Metrics and Databases: Citation databases (Web of Science, Scopus), metrics (impact factor, h-index, g-index, i10-index, altmetrics), journal metrics (SNIP, SJR, IPP, CiteScore).
Career Development: Strategies for successful publication, evaluating publication impact, building a research profile, and networking in the research community.
Publishing Controversial Research: Ethical considerations and responsible dissemination.

Text Books:

TB1. Bagchi, Kanak Kanti, Research Methodology in Social Sciences: A Practical Guide, Delhi, Abijeet Publications.
TB2. Kothari, C.R, Research Methodology: An Introduction, Delhi, New Age.

Reference Books:

RB1. Cooper, R. Donald and Pamela S. Schindler, Business Research Methods, Delhi, Tata McGraw-Hill.
RB2. Flyvbjerg, Bent, Making Social Science Matter: Why Social Inquiry Fails and How it can Succeed Again, United Kingdom, Cambridge University Press.
RB3. Goodde and Hatte, Methods in Social Research, New York, McGraw – Hill.

Course Outcome (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key ethical principles (e.g., plagiarism, informed consent) and research types in computer science.
CO2	Explain research design components (hypotheses, variables, sampling) and ethical guidelines.
CO3	Design a research methodology (quantitative/qualitative) and apply ethical data collection techniques (surveys, interviews).
CO4	Critique research papers for validity, reliability, and ethical compliance using statistical/content analysis tools (SPSS/R).
CO5	Assess authorship disputes, plagiarism cases, and societal impacts of CS research (e.g., AI bias, data privacy).
CO6	Develop a research paper with proper structure (abstract, literature review, citations) and justify methodological choices.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	3	1	1	1	1	1	1	1
CO2	3	2	2	3	2	1	1	1	2	1	1	1
CO3	2	3	3	3	2	2	2	1	3	2	2	2
CO4	1	2	2	3	2	1	1	1	2	1	2	1
CO5	1	1	1	2	3	2	2	2	1	2	3	3
CO6	2	3	2	3	1	2	3	3	1	3	3	3
AVG	1.8	2	1.8	2.5	2.2	1.5	1.7	1.5	1.7	1.7	2	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE702B**			
Course Name	**: SOFTWARE PROJECT MANAGEMENT**			
Semester / Year	**: 7th Semester / 4th Year**			
L	**T**	**P**	**C**	
3	**1**	**0**	**4**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the fundamental concepts and principles of software project management.
2. Gain knowledge of project initiation, planning, and estimation techniques.
3. Develop skills in project organization, team management, and effective communication.
4. Apply project execution and monitoring methodologies, such as Waterfall and Agile.
5. Analyze project risks and implement strategies for risk mitigation.
6. Demonstrate the ability to create project charters, scope statements, and schedules.

COURSE CONTENTS

Unit 1: Fundamentals of Software Project Management **[No. of Hours: 8]**
Introduction to Software Project Management (SPM), Characteristics of software projects, Role and responsibilities of a software project manager, Project initiation: Feasibility analysis, Project selection, Project charter and scope statement, Project estimation techniques: Expert judgment, Analogy, Parametric, Function Point Analysis, COCOMO Model

Unit 2: Project Planning and Scheduling **[No. of Hours: 9]**
Work Breakdown Structure (WBS), Project scheduling: Gantt Charts, PERT, CPM, Resource allocation and leveling, Project risk management: Risk identification, assessment, prioritization, mitigation strategies, and control

Unit 3: Project Execution, Monitoring, and Closure **[No. of Hours: 9]**
Project execution methodologies: Waterfall, Agile, and Hybrid models, Project tracking and performance monitoring, Change management, Earned Value Management (EVM), Project closure activities: Deliverable verification, Lessons learned, Knowledge transfer, Post-implementation review, Maintenance

Unit 4: Quality Assurance, Testing, and Configuration Management **[No. of Hours: 7]**
Software quality concepts, Software testing techniques: Test planning, execution, Black-box, White-box, Unit and Integration testing, Software configuration management: Baselines, Version control systems (Git, SVN), Change and release management

Unit 5: Team Management, Communication, Documentation, and Tools **[No. of Hours: 6]**
Project roles, team building, and team dynamics, Effective project communication, Project documentation: Requirements, Design, Test cases, User manuals, Document configuration management, Project management and collaboration tools: Microsoft Project, JIRA, Trello, Slack, GitHub

Text Books:

TB1. "Software Project Management: A Process-Driven Approach" by Ashfaque Ahmed
TB2. "Quality Software Project Management", Robert T. Futrell, Donald F. Shafer, and Linda I. Shafer, Pearson Education Asia.
TB3. "Managing Global Software Projects", Ramesh Gopalaswamy, Tata McGraw-Hill

Reference Books:

RB3. "Software Project Management: A Unified Framework" by Walker Royce
RB4. "A Guide to the Project Management Body of Knowledge (PMBOK® Guide)" by Project Management Institute (PMI)
RB5. "Project Management: A Systems Approach to Planning, Scheduling, and Controlling" by Harold Kerzner
RB6. "Managing the Software Process" by Watts S. Humphrey

Course Outcomes (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key concepts of software project management, including estimation techniques (COCOMO, FPA), scheduling methods (PERT/CPM), and risk management strategies.
CO2	Explain the phases of software project lifecycle (initiation, planning, execution, closure) and compare methodologies (Waterfall, Agile, Hybrid).
CO3	Apply project management tools (WBS, Gantt charts, EVM) and version control systems (Git) to plan and monitor software projects.
CO4	Analyze risks, resource constraints, and performance metrics (SPI, CPI) to troubleshoot project deviations.
CO5	Assess software quality through test cases (black-box/white-box) and recommend improvements for project deliverables.
CO6	Design a comprehensive project plan (charter, WBS, risk register) using industry tools (JIRA, MS Project) for a real-world scenario.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1	3	1	1	1	1	1
CO2	3	2	3	2	1	2	3	2	1	2	2	2
CO3	2	3	3	3	2	3	3	2	2	3	2	3
CO4	1	3	2	3	2	2	3	1	1	2	2	2
CO5	3	2	2	3	2	2	2	1	3	2	2	2
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	2.2	2.3	2.5	2.5	1.8	2.2	2.8	1.7	1.7	2.2	2	2.2

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE703A**				
Course Name	**: INTRODUCTION TO IOT/ MOOC ON IOT**				
Semester / Year	**: 7th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. To understand the basic concept of Internet of Things (IOT), its standards and components.
2. Learn the Network and Communication protocols for IoT.
3. Identify the role of controllers and sensors in IoT.

COURSE CONTENTS

Unit I IOT concepts **[No. of Hours: 8]**
Technologies that led to the evolution of IoT, IOT and SCADA, IOT and M2M, IoT and Big data

Unit II IoT Standards and Components **[No. of Hours: 8]**
IOT standards in practice, Operating platforms /systems. **IoT Components:** Design of IoT systems, Development of prototypes.

Unit III Challenges in IoT implementation. **[No. of Hours: 8]**
Big Data Management, Connectivity challenges, Mission-critical applications. Security issues in IOT

Unit IV IoT Applications (Case studies) **[No. of Hours: 8]**
Lighting as a service, Intelligent Traffic systems, Smart Parking, Smart water management etc.

Unit V Relevance of IoT for the future. **[No. of Hours: 8]**
IOT in everyday life, Internet of Everything, IOT and Individual Privacy. **IoT in Indian Scenario:** IOT and Aadhaar, IOT for health services, IOT for financial inclusion, IOT for rural empowerment.

Text Books:

TB1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press
TB2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer,
TB3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press
TB4. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Wiley

Reference Books:

RB1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT

RB2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications

RB3. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	**Detailed Statement of the CO**
CO1	Recall key IoT concepts, standards, and components (e.g., MQTT, SCADA, M2M).
CO2	Explain the role of IoT in real-world applications (e.g., smart traffic, water management) and its challenges (security, connectivity).
CO3	Develop IoT prototypes using platforms like Arduino/Raspberry Pi and integrate sensors/actuators.
CO4	Compare IoT communication protocols (e.g., CoAP vs. MQTT) and evaluate their suitability for specific use cases.
CO5	Assess security risks and ethical implications of IoT deployments (e.g., privacy, data ownership).
CO6	Design an IoT-based solution for a societal problem (e.g., smart agriculture, healthcare) using systematic methodologies.

CO-PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	2	3	2	2	2	2	2	2	1	2	2	2
CO3	2	2	3	3	1	3	2	2	2	2	2	3
CO4	1	3	2	3	1	2	1	2	3	1	1	2
CO5	1	2	1	2	3	1	1	2	1	1	3	2
CO6	1	3	3	3	2	3	3	3	2	3	3	3
AVG	**1.67**	**2.33**	**2**	**2.33**	**1.67**	**2.17**	**1.67**	**2**	**1.67**	**1.83**	**2**	**2.17**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE703B**				
Course Name	**: ADVANCE RDBMS/ MOOC ON ADVANCE RDBMS**				
Semester /Year	**: 7th Semester / 4th year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the concepts and principles of transaction processing in RDBMS.
2. Learn the techniques for ensuring recoverability and handling transaction failures.
3. Gain knowledge of concurrency control techniques and their application in managing concurrent transactions.
4. Explore the fundamentals of distributed DBMS, including data fragmentation, replication, and allocation.
5. Introduce the basics of Object-Oriented DBMS (OODBMS).
6. Develop critical thinking and analysis skills in evaluating and designing advanced RDBMS solutions.
7. Apply acquired knowledge to real-world scenarios through practical projects and case studies.

COURSE CONTENTS

UNIT I **[No. of Hours: 12]**

Transaction Processing Concepts: Transaction system, testing of serializability, Serializability of Schedules Conflict & view serializable, schedule

UNIT II **[No. of Hours: 6]**

Recoverability, Recovery from transaction failures, log based recovery, Checkpoints, deadlock handling

UNIT III **[No. of Hours: 12]**

Concurrency Control Techniques: Concurrency control, locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi-version Schemes, Recovery with concurrent transaction.

UNIT IV **[No. of Hours: 8]**

Distributed DBMS Concepts and design: Introduction, functions and architecture of a DDBMS, transaction Processing in Distributed system, data fragmentation. Replication and allocation techniques for distributed system, overview of concurrency control and recovery in distrusted database,

UNIT V **[No. of Hours: 2]**

Introduction to OODBMS.

Text Books:

TB1. Adv. DBMS by V.K. Jain, Cyber Tech Publication
TB2. Date C.J. "An Introduction to Database System". Addision Wesley

References Books:

RB1. Korth, Silbertz, Sudarshan, "Database Concepts" McGraw Hill
RB2. Elmasri, Navathe, "Fundamentals of Database Systems" Addision Wesley

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO #	Detailed Statement of the CO
CO1	Recall core concepts of transactions, ACID properties, and serializability (conflict/view) schedules.
CO2	Explain concurrency control protocols (locking, timestamping) and recovery techniques (log-based, checkpoints).
CO3	Implement serializability tests (precedence graphs) and deadlock handling mechanisms (wait-for graphs).
CO4	Compare distributed DBMS architectures (fragmentation, replication) and evaluate their trade-offs.
CO5	Assess the efficiency of concurrency control protocols (e.g., 2PL vs. MVCC) in real-world scenarios.
CO6	Design a distributed database solution with fragmentation/replication strategies for a given case study.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	1	1	1	2	3	1	1	1
CO2	3	2	2	2	1	2	2	2	3	2	1	1
CO3	2	3	3	3	1	2	2	2	3	2	2	2
CO4	2	3	3	3	2	2	3	2	3	2	2	3
CO5	2	3	3	3	2	3	2	3	2	3	2	2
CO6	2	3	3	3	2	3	3	3	3	3	3	3
AVG	**2.3**	**2.5**	**2.7**	**2.5**	**1.5**	**2.2**	**2.2**	**2.3**	**2.8**	**2.2**	**1.8**	**2**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE704A**				
Course Name	**: INTRODUCTION TO BLOCKCHAIN/ MOOC ON BLOCKCHAIN**				
Semester / Year	**: 7th Semester / 4th year**				
	L	**T**	**P**	**C**
	4	**0**	**0**	**4**

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop expertise related to the following: -

1. To provide Knowledge and concept of cryptography and blockchain.
2. To make familiar with Bitcoin and cryptocurrency with its various impact on blockchain.
3. To know about the Ethereum technology with its multiple aspects.
4. To provide an understanding about and Smart Contracts.
5. To develop an understanding about the various applications of Blockchain.

Course Content

Unit-I **[No. of Hours 10]**

Distributed systems, Blockchain, Generic elements of a blockchain, Benefits and limitations of blockchain, Tiers of blockchain technology, Features of a blockchain, Types of blockchain, Consensus,

Unit-II **[No. of Hours 10]**

Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations,

Unit-III **[No. of Hours 10]**

Cryptography: Symmetric Cryptography, Confidentiality, Integrity, Authentication, Non-repudiation, Public Key Cryptography: Asymmetric cryptography, Public and private keys, Hash functions

Unit-IV **[No. of Hours 10]**

Introduction to Bitcoin and Ethereum

Text Books:

TB1. Imran Bashir, Mastering Blockchain, Packt

Reference Books

RB1. Daniel Drescher, Block chain basics A non-technical introduction in 25 steps, Apress

RB2. Paul Vigna and Michael J.Casey. The Age of Cryptocurrency

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	*Recall* fundamental blockchain concepts, types, and consensus mechanisms.
CO2	*Explain* decentralization, smart contracts, and cryptographic principles in blockchain.
CO3	*Demonstrate* the use of wallets, transactions, and basic smart contracts in Bitcoin/Ethereum.
CO4	*Compare* consensus algorithms (PoW vs. PoS) and evaluate their trade-offs.
CO5	*Assess* real-world blockchain applications for security, scalability, and ethical implications.
CO6	*Design* a simple decentralized application or token using smart contracts.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	1	1	1	1
CO2	3	2	2	2	2	2	1	2	2	2	1	1
CO3	3	2	3	3	1	3	2	3	2	2	2	2
CO4	2	3	3	3	2	2	2	2	1	2	2	2
CO5	1	3	2	3	3	2	2	2	1	2	3	3
CO6	2	3	3	3	2	3	3	3	2	3	3	3
AVG	**2.3**	**2.3**	**2.3**	**2.5**	**1.8**	**2.3**	**1.8**	**2.3**	**1.5**	**2**	**2**	**2**

Course code	**: BCADSE704B**				
Course Name	**: NETWORK SECURITY AND CRYPTOGRAPHY/ MOOC ON NETWORK SECURITY AND CRYPTOGRAPHY**				
Semester / Year	**: 7th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Understand the basic Knowledge of Network Security Concepts & the Challenges and Scope of Information Security
2. Understand the basic Concept of Block Cipher, stream ciphers &the Importance of Cryptographic Algorithms and their Uses.
3. Learn and Understand Encryption Techniques & Access Control Mechanism Used for User Authentication and Authorization.
4. Understand the concept of authentication of message in network by using different techniques.
5. Aware and Learn the Usages of Sockets Layer (SSL), Secure Internet Protocol (IP) and HTTPS, Secure Electronic transaction.

COURSE CONTENTS:

UNIT 1: Introduction to security **[No. of Hours: 10]**

Basic aspects of Network security, Attacks active & passive attacks, Types of attack, VIRUS and its categories, Conventional Encryption, Conventional Encryption Model, Substitution & transposition techniques, Bit level encryption and operations. Block Cipher Design (Feistel and SP Network), Block Cipher Modes of Operations.

UNIT 2: Conventional Encryption Algorithms **[No. of Hours: 10]**

DES, DES Algorithm, DES standard, DES strength ,2DES, 3 DES, Men in Middle attack, AES, Blowfish, International Data Encryption Algorithm IDEA, RC-5, CAST-128, RSA, Key Distribution, Diffie Helmen Key Exchange Algorithm.

UNIT 3: Message Authentication & Hash Functions **[No. of Hours: 10]**

Authentication Requirements, Authentication Functions, Message Authentication Codes MAC, HMAC, Hash Function, Message Digest Algorithm: MD5 & SHA, Digital Signature, Standard (DDS), Proof of Digital Signature Algorithm, Digital certificate, X.509, X.25, Secure Electronic Transaction, Authentication Protocol, Authentication Applications: Kerberos.

UNIT4: Email, Internet Protocol Security **[No. of Hours: 10]**

Secure Socket Layer, Electronic Mail Security: PEM, Pretty Good Privacy (PGP), IP security Authentication Header, Encapsulating Security Payloads.

Text Book:

TB1. William Stallings, "Cryptography and Network Security: Principles and Practice", Prentice hall, New Jersey

Reference Books:

RB1. Johannes A. Buchmann, "Introduction to Cryptography" Springer-Verlag
RB2. Atul Kahate, "Cryptography and Network Security" TMH3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated.

Course Outcomes (OCs)

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of network security, types of attacks, and encryption techniques (e.g., DES, AES, RSA).
CO2	Explain the working principles of cryptographic algorithms (symmetric & asymmetric), hash functions (MD5, SHA), and authentication protocols (Kerberos, HMAC).
CO3	Implement basic encryption/decryption methods (Feistel cipher, block cipher modes) and security tools (PGP, SSL) in lab environments.
CO4	Compare security mechanisms (e.g., DES vs. AES, MAC vs. digital signatures) and assess vulnerabilities in cryptographic systems.
CO5	Judge the effectiveness of security protocols (IPSec, Diffie-Hellman) against real-world attacks (MITM, brute force).
CO6	Design a secure communication model using encryption, authentication, and digital signatures for a given scenario.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	1	1	1	1	1	1	1
CO2	3	2	2	2	1	2	1	2	1	2	1	1
CO3	3	3	3	3	2	2	2	3	2	2	2	2
CO4	2	3	3	3	2	2	2	3	1	2	2	2
CO5	2	3	3	3	3	2	2	3	1	3	2	2
CO6	2	3	3	3	3	3	3	3	2	3	3	3
AVG	**2.5**	**2.5**	**2.5**	**2.5**	**2**	**2**	**1.8**	**2.5**	**1.3**	**2.2**	**1.8**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAPR7**			
Course Name	**: DISSERTATION ON RESEARCH/ACADEMIC PROJECT - I**			
Semester / Year	**: 7th Semester / 4th Year**			
L	**T**	**P**	**C**	
0	**0**	**12**	**6**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop working expertise of solving complex computing problems through project-based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Identify the problem and describing it.
CO2	Understand the requirements of the chosen project.
CO3	Apply the collected requirements to define the describe the project in a systematic and comprehensive approach.
CO4	Analyze the technical aspects of the chosen project to find the possible solutions for development of the project.
CO5	Evaluate the effective reports and documentation for all project related activities and solutions.
CO6	Create plan for the project development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	1	1	1	1
CO2	2	3	2	2	1	1	3	1	1	1	1	1
CO3	2	3	3	3	1	1	3	1	2	1	1	2
CO4	3	3	3	3	1	2	2	1	2	2	1	2
CO5	1	2	2	2	3	1	3	1	3	1	2	2
CO6	1	2	2	2	1	1	3	2	1	1	1	3
AVG	**1.8**	**2.8**	**2.3**	**2.3**	**1.3**	**1.2**	**2.7**	**1.2**	**1.7**	**1.2**	**1.2**	**1.7**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

8th semester (BCA with Honours)

Course code	**: BCADSC801**				
Course Name	**: MACHINE LEARNING USING PYTHON**				
Semester / Year	**: 8th Semester / 4th Year**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Develop proficiency in Python programming, key libraries (NumPy, Pandas, scikit-learn), and data preprocessing techniques.
2. Build, train, and evaluate supervised (regression, classification) and unsupervised (clustering, PCA) models using real-world datasets.
3. Apply hyperparameter tuning, cross-validation, and model deployment (Flask) to create scalable ML solutions.
4. Interpret model performance using visualizations (Matplotlib/Seaborn) and present findings effectively.
5. Design end-to-end ML projects (e.g., customer segmentation, sentiment analysis) while considering ethical and technical constraints.

COURSE CONTENTS:

Unit 1: Python for Machine Learning **[No. of Hours: 8]**

Basics of Python programming, data types, loops, functions, key libraries including NumPy, Pandas, Matplotlib for data manipulation and visualization, setting up the environment, installing Anaconda, Jupyter Notebook, required packages, data preprocessing, handling missing data, normalization, encoding categorical variables, project on loading and exploring a dataset using Pandas and Matplotlib.

Unit 2: Implementing Supervised Learning **[No. of Hours: 8]**

Introduction to scikit-learn API, pipeline, linear regression implementation, training, visualization of results, logistic regression for building a binary classifier, evaluating performance, model evaluation using scikit-learn for accuracy, confusion matrix, ROC curves, project on predicting house prices using regression on a real-world dataset.

Unit 3: Unsupervised Learning with Python **[No. of Hours: 8]**

Clustering with scikit-learn, implementing K-means, hierarchical clustering, dimensionality reduction, applying PCA, t-SNE for data visualization, data visualization using Seaborn, Matplotlib for clustering results, preprocessing pipelines, combining preprocessing and modeling in scikit-learn, project on customer segmentation using clustering on a retail dataset.

Unit 4: Advanced Machine Learning Models **[No. of Hours: 8]**

Decision trees, random forests implementation, hyperparameter tuning, gradient boosting using XGBoost or LightGBM, introduction to neural networks, building a simple neural network with TensorFlow/Keras, model persistence, saving and loading models using joblib or pickle, project on classifying text data (e.g., sentiment analysis) using ensemble methods.

Unit 5: Model Optimization and Deployment **[No. of Hours: 8]**

Hyperparameter tuning, GridSearchCV, RandomizedSearchCV in scikit-learn, cross-validation, implementing k-fold cross-validation in Python, feature selection using scikit-learn's feature selection tools, model deployment basics, introduction to Flask for serving ML models, project on building and deploying a simple ML web application using Flask.

Text Book:

TB1. "Understanding Machine Learning: From Theory to Algorithms" by Shai Shalev-Shwartz and Shai Ben-David
TB2. "Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
TB3. "Machine Learning for Dummies" by John Paul Mueller and Luca Massaron

Reference Books:

RB1. "Pattern Recognition and Machine Learning" by Christopher M. Bishop
RB2. "Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy
RB3. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
RB4. "Introduction to Machine Learning" by Ethem Alpaydin
RB5. "Machine Learning: The Art and Science of Algorithms that Make Sense of Data" by Peter Flach
RB6. "Applied Predictive Modeling" by Max Kuhn and Kjell Johnson

Course Outcomes (OCs)

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of Python, key ML algorithms, and libraries (NumPy, Pandas, scikit-learn).
CO2	Explain the working principles of supervised/unsupervised learning models (e.g., linear regression, k-means clustering) and evaluation metrics (accuracy, ROC curves).
CO3	Implement ML pipelines (data preprocessing, model training, evaluation) using Python libraries for real-world datasets.
CO4	Compare and contrast different ML models (e.g., decision trees vs. random forests) and interpret results using visualization tools (Matplotlib, Seaborn).
CO5	Assess model performance using cross-validation, hyperparameter tuning (GridSearchCV), and justify algorithmic choices based on metrics.

CO6	Design and deploy an end-to-end ML application by integrating preprocessing, modeling, and optimization techniques.

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	2	1	1	1	2	-	-
CO2	3	2	2	2	-	2	1	2	1	2	-	-
CO3	2	3	3	3	-	3	2	3	2	3	1	1
CO4	2	3	3	3	1	2	2	3	1	2	1	1
CO5	1	3	3	3	2	2	2	3	1	2	2	2
CO6	1	3	3	3	3	3	3	3	2	3	3	3
AVG	**2**	**2.5**	**2.5**	**2.5**	**1.5**	**2.3**	**1.8**	**2.5**	**1.3**	**2.3**	**1.4**	**1.4**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAP81**				
Course Name	**: MACHINE LEARNING LAB**				
Semester / Year	**: 8th Semester / 4th Year**				
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Develop proficiency in Python programming, key libraries (NumPy, Pandas, scikit-learn), and data preprocessing techniques.
2. Build, train, and evaluate supervised (regression, classification) and unsupervised (clustering, PCA) models using real-world datasets.
3. Apply hyperparameter tuning, cross-validation, and model deployment (Flask) to create scalable ML solutions.
4. Interpret model performance using visualizations (Matplotlib/Seaborn) and present findings effectively.
5. Design end-to-end ML projects (e.g., customer segmentation, sentiment analysis) while considering ethical and technical constraints.

Course Outcomes (OCs)

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall syntax of Python ML libraries (NumPy, Pandas, scikit-learn) and steps in standard ML workflows.
CO2	Explain the purpose of data preprocessing techniques (normalization, encoding) and model evaluation metrics (accuracy, F1-score).
CO3	Implement supervised (linear regression, decision trees) and unsupervised (k-means, PCA) algorithms on given datasets using Python.
CO4	Diagnose model performance issues (overfitting/underfitting) by interpreting learning curves and confusion matrices.
CO5	Compare multiple ML models using cross-validation and justify optimal hyperparameters through GridSearchCV/RandomizedSearchCV.
CO6	Develop and demonstrate a complete ML pipeline (from data cleaning to deployment) for a real-world problem using Flask/Streamlit.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	2	-	1	1	2	-	-
CO2	3	2	2	2	1	2	1	2	1	2	-	-
CO3	2	3	3	3	1	3	2	3	2	3	1	1
CO4	2	3	3	3	2	2	2	3	1	2	2	1
CO5	1	3	3	3	2	2	2	3	1	2	2	2
CO6	1	3	3	3	3	3	3	3	2	3	3	3
AVG	**2**	**2.5**	**2.5**	**2.5**	**1.8**	**2.3**	**1.7**	**2.5**	**1.3**	**2.3**	**1.6**	**1.4**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE802A**				
Course Name	**: INTRODUCTION TO DEEP LEARNING/MOOC ON DEEP LEARNING**				
Semester / Year	**: 8th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives:

1. Introduce fundamental concepts of deep learning, including neural networks, activation functions, and optimization techniques.
2. Develop practical skills to design, implement, and train feedforward, convolutional (CNN), and recurrent (RNN) neural networks.
3. Analyze and compare different deep learning architectures for tasks like image classification, NLP, and sequential data modeling.
4. Evaluate model performance using appropriate metrics and techniques, including hyperparameter tuning and regularization.
5. Apply deep learning to real-world problems through hands-on projects, emphasizing ethical considerations and deployment challenges.

COURSE CONTENTS:

Unit 1: Foundations of Deep Learning **[No. of Hours: 8]**
Introduction to deep learning, neural network basics (neurons, layers, weights, biases), activation functions (sigmoid, ReLU), loss functions and gradient descent, deep learning frameworks (TensorFlow, PyTorch).

Unit 2: Building and Training Neural Networks **[No. of Hours: 8]**
Feedforward neural networks and forward propagation, backpropagation, regularization (dropout, L2), hyperparameter tuning (learning rate, batch size).

Unit 3: Convolutional Neural Networks (CNNs) **[No. of Hours: 8]**
CNN basics (convolutional and pooling layers), filters, strides, padding, CNN architectures (LeNet, AlexNet), image classification applications, hands-on: CNN for image classification (e.g., MNIST).

Unit 4: Recurrent Neural Networks (RNNs) **[No. of Hours: 8]**
RNNs for sequential data, LSTM and GRU, time-series and NLP applications, word embeddings (word2vec), RNN/LSTM for text or time-series data.

Unit 5: Advanced Topics **[No. of Hours: 8]**
Generative models (GANs, VAEs), transfer learning, applications (healthcare, autonomous vehicles), model deployment basics.

Text Book:

TB1. Deep Learning: A Practical Approach by Dr. Rajiv Chopra, Khanna Publishing House
TB2. Deep Learning: An Essential Guide to Deep Learning for Beginners by Herbert Jones
TB3. Deep Learning & Applications by Dr. A. Dennis Ananth, Dr.S.Markkandeyan, Dr. M. Rajakumaran, Dr. B. Lakshmi, Quill Tech Publications
TB4. Deep Learning by Example by Ahmed Menshawy by Packt

Reference Books:

RB1. Neural Networks and Deep Learning by Charu C. Aggarwal, Springer
RB2. Deep Learning By Example by Ahmed Menshawy, Packt
RB3. Deep learning Fundamentals and Applications for Beginners by Dr. A. GOPI KANNAN, SIP

Course Outcomes (OCs)

After completion of the course, a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall key concepts of neural networks, activation functions, and loss functions.
CO2	Explain the working of backpropagation, regularization techniques, and hyperparameter tuning.
CO3	Implement feedforward networks, CNNs, and RNNs using frameworks like TensorFlow/PyTorch.
CO4	Compare architectures like LeNet, AlexNet, and LSTMs for specific tasks (e.g., image/text data).
CO5	Assess model performance using metrics (accuracy, F1-score) and justify design choices (e.g., dropout rates).
CO6	Design a deep learning solution for a real-world problem (e.g., medical image segmentation or sentiment analysis).

CO-PO Mapping:

	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	2	1	1
CO2	3	2	2	2	1	2	1	1	1	2	1	1
CO3	3	3	3	3	1	3	2	2	2	3	2	2
CO4	3	2	2	3	1	2	2	2	1	2	2	2
CO5	2	3	3	3	2	2	2	3	1	2	2	2
CO6	3	3	3	3	3	3	3	3	1	3	3	3
AVG	2.8	2.3	2.3	2.5	1.5	2.3	1.8	2	1.2	2.3	1.8	1.8

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE802B**				
Course Name	**: CLOUD COMPUTING/ MOOC ON CLOUD COMPUTING**				
Semester	**: 8th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Understand the fundamental concepts, characteristics, and benefits of cloud computing.
2. Explain the different service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid) in cloud computing.
3. Apply virtualization technologies to create and manage virtual machines or containers.
4. Deploy and manage applications on cloud platforms using IaaS and PaaS models.
5. Analyze the security challenges in cloud computing and implement appropriate security measures.
6. Evaluate and compare cloud storage, database services, and cloud service providers.
7. Develop strategies for cloud migration, integration, and cost optimization.
8. Monitor and manage cloud resources using automation and orchestration techniques.
9. Design scalable and resilient cloud architectures for real-world scenarios.

COURSE CONTENTS

Unit 1: Introduction to Cloud Computing **[No. of Hours: 8]**

Definition, characteristics, and benefits of cloud computing, Evolution and challenges of cloud computing, Cloud service models: IaaS, PaaS, SaaS, Cloud deployment models: Public, private, hybrid, community clouds

Unit 2: Virtualization and Infrastructure as a Service (IaaS) **[No. of Hours: 8]**

Virtualization concepts, benefits, and types: server, storage, network, Virtualization technologies: VMware, Xen, Hyper-V, IaaS fundamentals: virtual machines, containers, Key IaaS providers: AWS, Microsoft Azure, Google Cloud Platform

Unit 3: Platform as a Service (PaaS) and Software as a Service (SaaS) **[No. of Hours: 8]**

PaaS: cloud application development, deployment, and scaling, PaaS providers: Heroku, Google App Engine, Azure App Service, SaaS: cloud-based productivity and collaboration tools, SaaS providers: Salesforce, Google Workspace, Microsoft 365

Unit 4: Cloud Storage, Databases, and Security **[No. of Hours: 8]**

Cloud storage services: Amazon S3, Google Cloud Storage, Cloud databases: Amazon RDS, Google Cloud SQL, NoSQL (MongoDB, Cassandra), Security challenges, identity and access management, Data privacy, compliance, and cloud security best practices

Unit 5: Cloud Migration, Integration, and Management **[No. of Hours: 8]**

Cloud migration strategies and planning, Integration technologies: APIs, web services, hybrid architectures, Monitoring, logging, and infrastructure automation, Cost optimization and management platforms: AWS CloudFormation, Azure Resource Manager

Text Books:

TB1. V.K. Pachghare ,"Cloud Computing "PHI Learning

TB2. Venkata Josyula, Malcom Orr, Greg Page, "Cloud Computing Automating the Virtualized Data Center", Cisco Press

TB3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing a Practical Approach", McGraw Hill

Reference Books:

RB1. Erl Thomas, Puttini Ricardo, Mahmood Zaigham, "Cloud Computing-Concepts, Technology and Architecture", Pearson India

RB2. Magroski Goulart, VasfiGucer, Rahul Gupta, Shamim Hossain, David Kwock, Jordan T Moore, David N Nguyen, Bobby Woolf, "Hybrid Cloud Data and API Integration: Integrate Your Enterprise and Cloud with Bluemix Integration Services", IBM Redbooks

Course Outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of cloud computing, including service models (IaaS/PaaS/SaaS) and deployment strategies (public/private/hybrid).
CO2	Explain the role of virtualization in cloud infrastructure and compare key IaaS providers (AWS/Azure/GCP).
CO3	Deploy virtual machines, containers, and cloud storage solutions using platforms like AWS or Azure.
CO4	Assess security risks in cloud environments and design IAM policies to mitigate vulnerabilities.
CO5	Compare cloud migration strategies and justify cost-optimization techniques for real-world scenarios.
CO6	Sketch a basic cloud architecture diagram for a given use case, labeling the service models (IaaS/PaaS/SaaS) and deployment types used.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	1	1	1	1	1
CO2	2	3	2	2	1	2	1	1	1	1	2	1
CO3	2	2	3	3	1	3	2	2	3	2	1	2
CO4	1	2	2	3	3	1	1	1	2	1	1	1
CO5	1	3	2	2	2	2	3	3	1	2	2	2
CO6	1	1	3	2	1	1	2	1	1	1	3	2
AVG	**1.67**	**2**	**2.17**	**2.17**	**1.5**	**1.83**	**1.67**	**1.5**	**1.5**	**1.33**	**1.67**	**1.33**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE803A**				
Course Name	**: ALGORITHMS ANALYSIS & DESIGN/ MOOC ON ALGORITHMS ANALYSIS & DESIGN**				
Semester /Year	**: 8th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

COURSE OBJECTIVES:

In this course, the learners will be able to develop expertise related to the following:-

1. Understand the important concepts of algorithms design and their analysis.
2. Analyze the efficiency of alternative algorithmic solutions to the problem.
3. Understand different algorithm paradigms like Divide and Conquer, Greedy, Dynamic,Backtracking and Branch and Bound.
4. Identify the appropriate data structures, algorithm design techniques and assess theirimpact on the performance of programs.

COURSE CONTENTS

UNIT-I **[No. of Hours: 09]**

Algorithms, Analysis of Algorithms, Design of Algorithms, and Complexity of Algorithms Growth of Functions: Asymptotic notations, Recurrences and Solution of Recurrence Equations, The Master Method.

UNIT-II **[No. of Hours: 09]**

Sorting in polynomial Time: Insertion sort, Merge sort, Heap sort, and Quick sort, Sorting in Linear Time: Radix Sort, Bucket Sort.

UNIT-III **[No. of Hours: 09]**

Greedy Technique: Fractional Knapsack Problem, Activity Selection Problem, Dynamic Programming: 0/1 Knapsack Problem, Branch-and-Bound: Assignment Problem, Traveling Salesperson Problem;

UNIT-IV **[No. of Hours:09]**

Graph: Introduction, Representation of Graph, BFS, DFS, Minimum Spanning Tree: Prims Algorithm, Kruskal Algorithm, Single Source Shortest Paths: Bellman-Ford Algorithm, Dijkstra Algorithm, All Pair Shortest Paths: Floyd-Warshall Algorithm.

UNIT-V **[No. of Hours:04]**

NP-Completeness: P, NP, NP-Hard & NP-Complete Class.

Text Books:

TB1. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, "Introduction to Algorithms", PHI

TB2. S. Dasgupta, C. Papadimitriou and U.Vazirani, "Algorithms", McGraw Hill Higher Education
TB3. J. Kleinberg and E. Tardos, "Algorithm Design", Pearson Education

Reference Books:

RB1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, Prentice-Hall of India,
RB2. Ellis Horowitz, Sartaj Sahni, S. Rajasekharan: Fundamentals of Computer Algorithms, Universities press,
RB3. Anany Levitin: Introduction to The Design & Analysis of Algorithms, Pearson Education.
RB4. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning.
RB5. Baase: Computer Algorithms: Introduction to Design and Analysis, Addis

Course Outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental algorithmic paradigms (e.g., greedy, dynamic programming) and asymptotic notations (Big-O, Ω, Θ)
CO2	Explain the working principles of sorting algorithms (e.g., QuickSort, Counting Sort) and graph traversals (BFS/DFS).
CO3	Implement non-recursive and recursive algorithms (e.g., Fibonacci, Merge Sort) using appropriate data structures.
CO4	Compare time/space complexity of algorithms (e.g., Dijkstra vs. Bellman-Ford) and solve recurrence relations.
CO5	Judge the suitability of algorithmic techniques (e.g., DP vs. backtracking) for real-world problems (e.g., Knapsack, TSP).
CO6	Design optimized solutions for computational problems (e.g., MST using Prim's/Kruskal's) and justify design choices.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	-	1	-	1	-	1	-	-
CO2	3	2	2	2	-	1	-	1	1	1	-	-
CO3	3	2	3	3	1	2	1	2	2	2	1	1
CO4	2	3	3	3	-	2	2	2	1	2	-	1
CO5	1	3	3	3	2	2	3	2	-	2	1	2
CO6	2	3	3	3	2	3	3	3	2	3	2	3
AVG	**2.33**	**2.33**	**2.67**	**2.5**	**1.25**	**1.83**	**1.5**	**1.83**	**1.2**	**1.83**	**0.83**	**1.17**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCADSE803B**				
Course Name	**: COMPUTER GRAPHICS/ MOOC ON COMPUTER GRAPHICS**				
Semester /Year	**: 8th Semester / 4th Year**				
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

1. Introduces the basic concepts of computer graphics
2. Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis.
3. Use of geometric transformations on graphics objects and their application in composite form.

COURSE CONTENT

Unit 1: Introduction to Computer Graphics **[No. of Hours: 2]**

Overview of computer graphics and its applications, Graphics pipeline and stages, Raster and vector graphics

Unit 2: Mathematics for Computer Graphics **[No. of Hours: 6]**

Vector algebra and geometry transformations, Matrices and transformations, Homogeneous coordinates and transformations, 2D and 3D coordinate systems

Unit 3: 2D Graphics **[No. of Hours: 8]**

Graphics primitives and attributes, Scan-conversion algorithms, Line drawing algorithms (Bresenham's line algorithm), Circle drawing algorithms, Filling algorithms (Boundary fill, flood fill)

Unit 4: 3D Graphics **[No. of Hours: 8]**

3D transformations (translation, rotation, scaling), Projection and viewing transformations
Hidden surface removal algorithms (depth sorting, z-buffering), Shading and lighting models

Unit 5: Rendering Techniques **[No. of Hours: 8]**

Introduction to rendering and rasterization, Color models and color spaces, Anti-aliasing techniques, Texture mapping and mapping coordinates, Ray tracing basics

Unit 6: Computer Animation **[No. of Hours: 8]**

Animation principles and techniques, Keyframe animation, Interpolation methods (linear, quadratic, cubic), Skeletal animation and inverse kinematics, Particle systems

Text Books:

TB1. Donald Hearn and M Pauline Baker, "Computer Graphics" PHI
TB2. Steven Harrington, "Computer Graphics: A Programming Approach" TMH
TB3. Prajapati A.K. "Computer Graphics" PPM

References Books:

RB1. Foley James D, "Computer Graphics" AW
RB2. Newman and Sproull, "Principle of to Interactive Computer Graphics" McGraw Hill
RB3. Rogers, "Procedural Elements of Computer Graphics", McGraw Hill
RB4. Rogers and Adams, "Mathematical Elements of Computer Graphics" McGraw Hill

Course Outcomes (COs):
Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Recall fundamental concepts of computer graphics, including raster vs. vector graphics, pipeline stages, and key algorithms (e.g., Bresenham's line drawing).
CO2	Explain the mathematical foundations (vectors, matrices, homogeneous transformations) and their role in 2D/3D graphics.
CO3	Implement scan-conversion algorithms (e.g., boundary fill, flood fill) and 3D transformations (translation, rotation, scaling) using programming tools.
CO4	Compare rendering techniques (e.g., z-buffering vs. depth sorting) and shading models (Phong vs. Gouraud) to determine efficiency and visual quality.
CO5	Assess the ethical and societal implications of computer graphics technologies (e.g., deepfakes, GPU energy consumption).
CO6	Design a 3D animation or interactive graphics project (e.g., game scene, ray-traced image) by integrating principles of shading, texture mapping, and keyframe animation.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	2	1	2	1	2	1	1
CO2	3	2	2	2	1	1	1	1	1	1	1	1
CO3	3	3	3	3	1	2	2	2	1	2	2	2
CO4	3	3	2	3	1	2	2	2	1	2	1	2
CO5	1	1	1	1	3	2	1	1	1	2	3	2
CO6	3	3	3	3	2	3	3	3	2	3	3	3
AVG	**2.7**	**2.2**	**2**	**2.2**	**1.5**	**2**	**1.7**	**1.8**	**1.2**	**2**	**1.8**	**1.8**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

Course code	**: BCAPR8**			
Course Name	**: DISSERTATION ON ACADEMIC PROJECT - II**			
Semester / Year	**: 8th Semester / 4th Year**			
L	**T**	**P**	**C**	
0	**0**	**12**	**6**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop working expertise of solving complex computing problems through project-based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Identify the problem and describing it.
CO2	Understand the requirements of the chosen project.
CO3	Apply the collected requirements to define the describe the project in a systematic and comprehensive approach.
CO4	Analyze the technical aspects of the chosen project to find the possible solutions for development of the project.
CO5	Evaluate the effective reports and documentation for all project related activities and solutions.
CO6	Create plan for the project development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	1	1	1	1
CO2	2	3	2	2	1	1	3	1	1	1	1	1
CO3	2	3	3	3	1	1	3	1	2	1	1	2
CO4	3	3	3	3	1	2	2	1	2	2	1	2
CO5	1	2	2	2	3	1	3	1	3	1	2	2
CO6	1	2	2	2	1	1	3	2	1	1	1	3
AVG	**1.8**	**2.8**	**2.3**	**2.3**	**1.3**	**1.2**	**2.7**	**1.2**	**1.7**	**1.2**	**1.2**	**1.7**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated

8th Semester BCA (Honours with Research)

Course code	**: BCARP8**				
Course Name	**: DISSERTATION ON RESEARCH PROJECT - II**				
Semester / Year	**: 8th Semester / 4th Year**				
	L	**T**	**P**	**C**	
	0	**0**	**12**	**6**	

L - Lecture T – Tutorial P – Practical C – Credit

Course Objectives: The objectives of this course are

In this course, the learners will be able to develop working expertise of solving complex computing problems through project-based learning approach using real world case studies by implementing the concepts studied in the theory courses of this semester.

Course outcomes (COs):

Upon successful completion of the course a student will be able to

CO#	Detailed Statement of the CO
CO1	Identify the problem and describing it.
CO2	Understand the requirements of the chosen project.
CO3	Apply the collected requirements to define the describe the project in a systematic and comprehensive approach.
CO4	Analyze the technical aspects of the chosen project to find the possible solutions for development of the project.
CO5	Evaluate the effective reports and documentation for all project related activities and solutions.
CO6	Create plan for the project development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	1	1	2	1	1	1	1	1
CO2	2	3	2	2	1	1	3	1	1	1	1	1
CO3	2	3	3	3	1	1	3	1	2	1	1	2
CO4	3	3	3	3	1	2	2	1	2	2	1	2
CO5	1	2	2	2	3	1	3	1	3	1	2	2
CO6	1	2	2	2	1	1	3	2	1	1	1	3
AVG	**1.8**	**2.8**	**2.3**	**2.3**	**1.3**	**1.2**	**2.7**	**1.2**	**1.7**	**1.2**	**1.2**	**1.7**

3: Highest Correlated, 2: Medium Correlated, 1: Lowest Correlated