



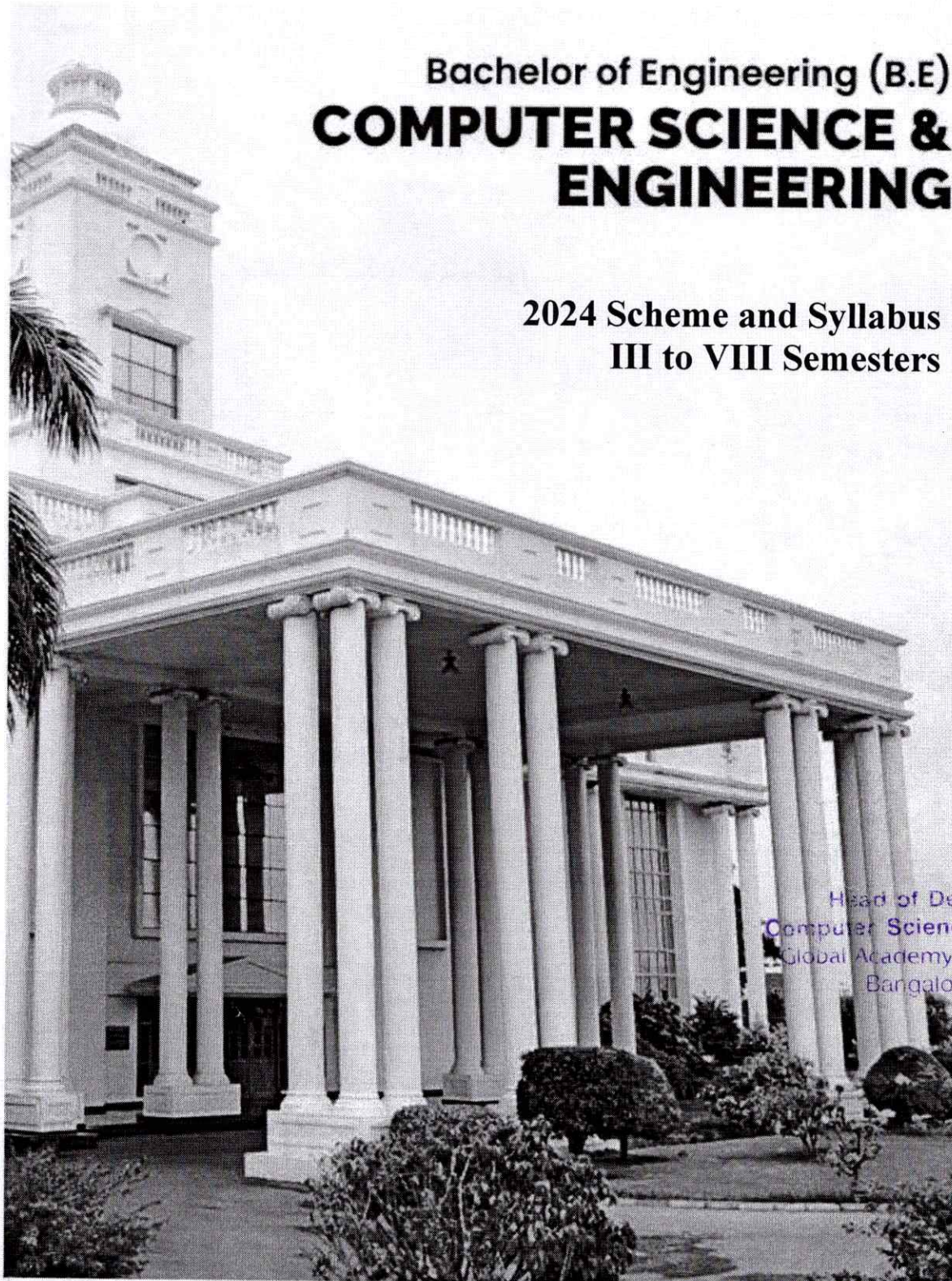
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Bachelor of Engineering (B.E) **COMPUTER SCIENCE & ENGINEERING**

**2024 Scheme and Syllabus
III to VIII Semesters**



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Computer Science Engineering
Global Academy of Technology
Bengaluru 98

Professor & Associate Dean Academics
Global Academy of Technology
Bengaluru - 560098.

BE Programs: CS, IS, AI&DS, EC, CS-AI&ML, EE, ME, CE, AE, AI&ML

PG Programs: M.Tech (CSE), M.Tech(Structural Engg.), MBA

Ph.D Programs: VTU Affiliated Research Centers in Engineering



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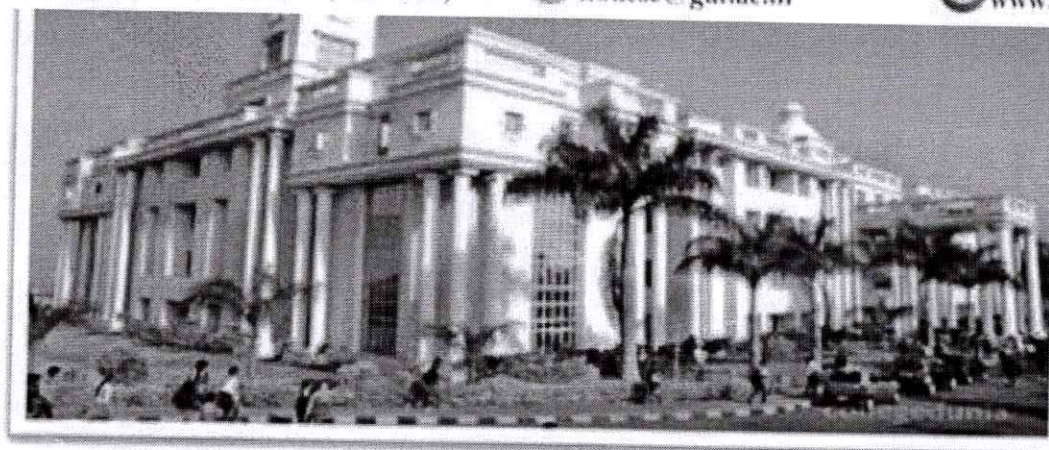
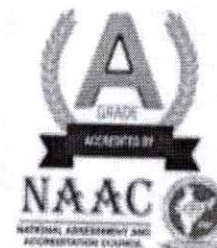
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Bachelor of Engineering (B.E) in COMPUTER SCIENCE AND ENGINEERING

Vision

To achieve academic excellence and strengthen the skills to meet emerging challenges of computer science and engineering.

Mission

- M1: To impart strong theoretical foundation in the field of Computer Science and Engineering accompanied with extensive practical skills.
- M2: To inculcate research and innovation spirit through interaction with industry and carry out projects that address societal needs.
- M3: Instill professional ethics and values with a concern for environment.


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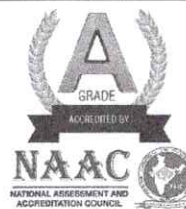
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Scheme of Teaching and Examinations 2024

(with effect from AY 2024-25)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC/ BSC	BMATS24301	Discrete Mathematics	TD: MAT, PSB: MAT	3	0	0		03	50	50	100	3
2	IPCC	BCS24302	Data Structures and Applications	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
3	IPCC	BCS24303	Digital Design and Computer Organization	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
4	PCC	BCS24304	Operating Systems	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
5	PCCL	BCSL24305	Unix Shell Programming	TD: CSE, PSB: CSE	0	0	2		03	50	50	100	1
6	ETC/ PLC	BCS24306x	ETC/PLC	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
7	UHV	BSCK24307	Social Connect and Responsibility	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	BCS24358x	Ability Enhancement Course/ Skill Enhancement Course - III	TD: CSE, PSB: CSE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is Lab				02				
					0	0	2						
9	MC	BNSK24359	National Service Scheme (NSS)	NSS Coordinator	0	0	2		---	100	---	100	0
		BPEK24359	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24359	Yoga	Yoga Teacher									
		BLAK24359	Music	Music Teacher									

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				Total	550	350	900	20
PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical S= SDA: Skill Development Activity, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course								
Emerging Technology Course /Programming Language Course (ETC/PLC)								
BCS24306A	Programming with Julia			BCS24306C	Cyber Security			
BCS24306B	Object Oriented Programming with C++			BCS24306D	Robotic Process Automation			
Ability Enhancement Course – III								
BCS24358A	Data Analytics with Excel			BCS24358C	Functional Programming with Scala			
BCS24358B	Data Visualization Techniques			BCS24358D	Project Management with Git			



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Scheme of Teaching and Examinations 2024

(with effect from AY 2024-25)

IV SEMESTER

SEMESTER													
Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC/ BSC	BMATS24401	Probability and Graph Theory	TD: MAT, PSB: MAT	3	0	0		03	50	50	100	3
2	IPCC	BCS24402	Object Oriented Programming with Java	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
3	PCC	BCS24403	Software Engineering	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
4	PCC	BCS24404	Design and Analysis of Algorithms	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
5	PCCL	BCSL24405	Algorithms Lab	TD: CSE, PSB: CSE	0	0	2		03	50	50	100	1
6	ETC/ PLC	BCS24406x	ETC/PLC	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
7	AEC/ SEC	BCS24457x	Ability Enhancement Course/ Skill Enhancement Course - IV	TD: CSE, PSB: CSE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is Lab				02				
					0	0	2						
8	BSC	BBOK24407	Biology For Engineers	TD / PSB: BT, CHE	1	0	0		01	50	50	100	1
9	UHV	BUHK24408	Universal Human Values	Any Department	1	0	0		01	50	50	100	1

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10	MC	BNSK24459	National Service Scheme (NSS)	NSS coordinator	0	0	2		--	100	---	100	0
		BPEK24459	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24459	Yoga	Yoga Teacher									
		BLAK24459	Music	Music Teacher									

Total 550 450 1000 20

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **UHV:** Universal Human Value Course, **MC:** Mandatory Course (Non-credit), **AEC:** Ability Enhancement Course, **SEC:** Skill Enhancement Course, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **K:** This letter in the course code indicates common to all the stream of engineering.

Emerging Technology Course /Programming Language Course (ETC/PLC)

BCS24406A	Computational Data Science	BCS24406C	Augmented Reality and Virtual Reality
BCS24406B	Data Analytics with R Programming	BCS24406D	Optimization Techniques

Ability Enhancement Course / Skill Enhancement Course – IV

BCS24457A	MATLAB Essentials	BCS24457C	Full Stack Framework (Frontend)
BCS24457B	User Experience and Interface Design	BCS24457D	Technical Writing using LATEX



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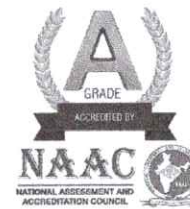
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V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMC	BCS24501	Engineering Economics, Management and Entrepreneurship	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
2	IPCC	BCS24502	Computer Networks	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
3	PCC	BCS24503	Database Management Systems	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
4	PCCL	BCSL24504	DBMS Lab with Mini Project	TD: CSE, PSB: CSE	0	0	2		03	50	50	100	1
5	PEC	BCS24505x	Professional Elective Course - I	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
6	AEC/ SEC	BCS24556x	Ability Enhancement Course/ Skill Enhancement Course - V	TD: CSE, PSB: CSE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is Lab				02				
					0	0	2						
7	PROJ	BCSP24507	Mini Project	TD: CSE, PSB: CSE	0	0	4		03	100	---	100	2
8	AEC	BRMK24557	Research Methodology and IPR	Any Department	3	0	0		03	50	50	100	3
9	MC	BESK24508	Environmental Studies	TD: CV, PSB: CV	1	0	0		---	100	---	100	0
10	MC	BNSK24559	National Service Scheme (NSS)	NSS coordinator	0	0	2		---	100	---	100	0
		BPEK24559	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24559	Yoga	Yoga Teacher									

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		BLAK24559	Music	Music Teacher										
										Total	650	350	1000	20
Professional Elective Course - I														
BCS24505A	Natural Language Processing				BCS24505C	Design Patterns								
BCS24505B	Microcontrollers and Embedded systems				BCS24505D	Agile Technology								
Ability Enhancement Course / Skill Enhancement Course – V														
BCS24556A	Software design using plant UML				BCS24556C	Full Stack Framework (Backend)								
BCS24556B	Competitive Programming				BCS24556D	Automated Software Testing with Tosca								



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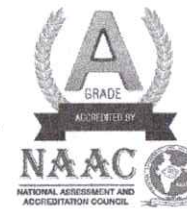
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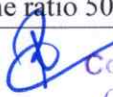
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VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits	
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks		
					L	T	P	S						
1	IPCC	BCS24601	Machine Learning	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4	
2	PCC	BCS24602	Cloud Computing and Big Data Analytics	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3	
3	PCC	BCS24603	Theory of Computation and Compiler Design	TD: CSE, PSB: CSE	2	2	0		03	50	50	100	3	
4	PEC	BCS24604x	Professional Elective Course - II	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3	
5	OEC	BCS24605x	Open Elective Course - I	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3	
6	PROJ	BCSP24606	Project Phase - I	TD: CSE, PSB: CSE	0	0	4		03	100	---	100	2	
7	PCCL	BCSL24607	Mobile App Development using Flutter	TD: CSE, PSB: CSE	0	0	2		03	50	50	100	1	
8	AEC/ SDC	BCS24657x	Ability Enhancement Course/ Skill Development Course VI	TD: CSE, PSB: CSE	If the course is Theory				01	50	50	100	1	
					1	0	0							
					If the course is Lab				02					
					0	0	2							
9	IKS	BIKS24608	Indian Knowledge System	Any Dept.	1	0	0		---	100	---	100	0	
10	MC	BNSK24659	National Service Scheme (NSS)	NSS coordinator	0	0	2		---	100	---	100	0	

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		BPEK24659	Physical Education (PE) (Sports and Athletics)	Physical Education Director										
		BYOK24659	Yoga	Yoga Teacher										
		BLAK24659	Music	Music Teacher										
11	MC	BDMP24609	Disaster Management and Preparedness	TD: CV, PSB: CV	2	0	0		---	100	---	100	0	
										Total	750	350	1100	20
Professional Elective Course - II														
BCS24604A		Computer Vision		BCS24604C	Adhoc Wireless Technology									
BCS24604B		Advanced Java Programming		BCS24604D	Enterprise Architecture									
Open Elective Course - I														
BCS24605A		MongoDB for Developers		BCS24605C	Cloud Computing									
BCS24605B		Data Visualization using Python		BCS24605D	Full Stack Framework – Frontend Tools									
Ability Enhancement Course / Skill Enhancement Course-V														
BCS24657A		Prototyping Internet of Smart Devices		BCS24657C	Software Development Approach with DevOps									
BCS24657B		Project Management with Jira		BCS24657D	Selenium Automation Testing									
Project Phase - I														
The objective of the Project work Phase - I is • To encourage independent learning and the innovative attitude of the students. • To develop interactive attitude, communication skills, organization, time management, and presentation skills. • To impart flexibility and adaptability. • To inspire team working. • To expand intellectual capacity, credibility, judgment and intuition. • To adhere to punctuality, setting and meeting deadlines. • To install responsibilities to oneself and others. • To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve ingroup discussion to present and exchange ideas.														
CIE procedure for Project Phase - I:														
(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.														
The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.														


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(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.



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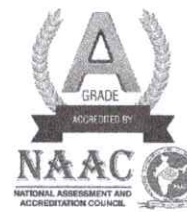
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VII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BCS24701	Deep Learning and Generative AI	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
2	IPCC	BCS24702	Cryptography and Network Security	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
3	PCC	BCS24703	Cryptocurrency and Blockchain Technology	TD: CSE, PSB: CSE	2	2	0		03	50	50	100	3
4	PEC	BCS24704x	Professional Elective Course / (Online) - III	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
5	OEC	BCS24705x	Open Elective Course / (Online) - II	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
6	PROJ	BCSP24706	Major Project Phase - II	TD: CSE, PSB: CSE	0	0	14		03	100	100	200	7
									Total	350	350	700	24

Professional Elective Course – III

BCS24704A	Soft Computing	BCS24704C	Quantum Computing
BCS24704B	NoSQL databases	BCS24704D	Cloud Data Platforms and Analytics

Open Elective Course – II

BCS24705A	Computational Data Science	BCS24705C	Cyber Security and Ethical Hacking
BCS24705B	Data Visualization using Tableau and Power BI	BCS24705D	Full Stack Framework – Backend Tools

PCC: Professional Core Course, **PCCL:** Professional Core Course laboratory, **PEC:** Professional Elective Course, **OEC:** Open Elective Course **PR:** Project Work, **L:** Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD-** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work.

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Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester.

(2) Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Project Phase – II

The objective of the Project work Phase II is

- To encourage independent learning and the innovative attitude of the students.
- To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team working.
- To expand intellectual capacity, credibility, judgment and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To install responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve ingroup discussion to present and exchange ideas.

CIE procedure for Project Phase II:

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.



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VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question and Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BCS24801x	Professional Elective (Online Courses) - IV	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
2	PEC	BCS24802x	Professional Elective (Online Courses) - V	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
3	INT	BCS24803	Internship (Industry/Research) (14 - 20 weeks)	TD: CSE, PSB: CSE	0	0	12		03	100	100	200	10
Total										200	200	400	16

Professional Elective Course (Online courses) – IV

BCS24801A	NPTEL / VTU online	BCS24801C	NPTEL / VTU online
BCS24801B	NPTEL / VTU online	BCS24801D	NPTEL / VTU online

Professional Elective Course (Online courses) – V

BCS24802A	NPTEL / VTU online	BCS24802C	NPTEL / VTU online
BCS24802B	NPTEL / VTU online	BCS24802D	NPTEL / VTU online

L: Lecture, **T:** Tutorial, **P:** Practical **S= SDA:** Skill Development Activity, **CIE:** Continuous Internal Evaluation, **SEE:** Semester End Evaluation. **TD-** Teaching Department, **PSB:** Paper Setting department, **OEC:** Open Elective Course, **PEC:** Professional Elective Course. **PROJ:** Project work, **INT:** Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester.

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- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation centre, Start-up, centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.



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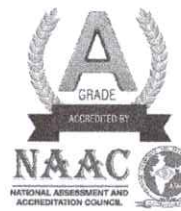
+91 80 28603158(Ext - 300)



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Scheme of Teaching and Examinations 2024

(with effect from AY 2024-25)

VI SEMESTER (A)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BCS24601	Machine Learning	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
2	PCC	BCS24602	Cloud Computing and Big Data Analytics	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
3	PCC	BCS24603	Theory of Computation and Compiler Design	TD: CSE, PSB: CSE	2	2	0		03	50	50	100	3
4	PEC	BCS24604x	Professional Elective Course - II	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
5	OEC	BCS24605x	Open Elective Course - I	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
6	PROJ	BCSP24606	Project Phase - I	TD: CSE, PSB: CSE	0	0	4		03	100	---	100	2
7	PCCL	BCSL24607	Mobile App Development using Flutter	TD: CSE, PSB: CSE	0	0	2		03	50	50	100	1
8	AEC/ SDC	BCS24657x	Ability Enhancement Course/ Skill Development Course V	TD: CSE, PSB: CSE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is Lab				02				
					0	0	2						
9	IKS	BIKS24608	Indian Knowledge System		1	0	0		---	100	---	100	0
10	MC	BNSK24659	National Service Scheme (NSS)	NSS coordinator	0	0	2		---	100	---	100	0
		BPEK24659	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK24659	Yoga	Yoga Teacher									

[Signature]

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		BLAK24659	Liberal Arts	Prominent NGO									
11	MC	BDMP24609	Disaster Management and Preparedness	TD: CV, PSB: CV	2	0	0		---	100	---	100	0
Total										750	350	1100	20

Professional Elective Course - II			
BCS24604A	Computer Vision	BCS24604C	Adhoc Wireless Technology
BCS24604B	Advanced Java Programming	BCS24604D	Enterprise Architecture
Open Elective Course - I			
BCS24605A	MongoDB for Developers	BCS24605C	Cloud Computing
BCS24605B	Data Visualization using Python	BCS24605D	Full Stack Framework – Frontend Tools
Ability Enhancement Course / Skill Enhancement Course-V			
BCS24657A	Prototyping Internet of Smart Devices	BCS24657C	Software Development Approach with DevOps
BCS24657B	Project Management with Jira	BCS24657D	Selenium Automation Testing

Project Phase - I

The objective of the Project work Phase - I is

- To encourage independent learning and the innovative attitude of the students.
- To develop interactive attitude, communication skills, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire team working.
- To expand intellectual capacity, credibility, judgment and intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To install responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve ingroup discussion to present and exchange ideas.

CIE procedure for Project Phase - I:

Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.



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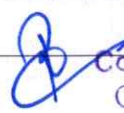


Scheme of Teaching and Examinations 2024

(with effect from AY 2024-25)

VII and VIII semesters for the candidate those who seek an internship with project work (A)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	SDA	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	IPCC	BCS24701	Deep Learning and Generative AI (To be completed in 5 th /6 th semester)	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
2	IPCC	BCS24702	Cryptography and Network Security (To be completed in 5 th /6 th semester)	TD: CSE, PSB: CSE	3	0	2		03	50	50	100	4
3	PCC	BCS24703	Cryptocurrency and Blockchain Technology (To be completed in 5 th /6 th semester)	TD: CSE, PSB: CSE	2	2	0		03	50	50	100	3
4	PEC	BCS24704x	Professional Elective Course / Online - III	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
5	OEC	BCS24705x	Open Elective Courses / Online - II	TD: CSE, PSB: CSE	3	0	0		01	50	50	100	3
1	PEC	BCS24801x	Professional Elective (MOOC Courses) - IV	TD: CSE, PSB: CSE	3	0	0		03	50	50	100	3
2	PEC	BCS24802x	Professional Elective (MOOC Courses) - V	TD: CSE, PSB: CSE	3	0	0		01	50	50	100	3
3	INT	BCS24803	Internship (Industry/Research) (02 semesters)	TD: CSE, PSB: CSE	0	0	12		03	100	100	200	10
4	PROJ	BCSP24804	Major Project II - outcome of training	TD: CSE, PSB: CSE	0	0	14		03	100	100	200	7
Head of Department									Total	550	550	1100	40


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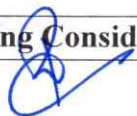
ASSESSMENT DETAILS

1. Evaluation of PCC / ESC / ETC Courses

Assessment	Actual Weightage in Marks		Final weightage in Marks
CIE 1	50		Average of 2 CIEs out of 30
CIE 2	50		
AAT	No. of AATs planned	Marks	20
	1	20	
	2	10 + 10	
	3	05 + 05 + 10	
	4	05 + 05 + 05 + 05	
SEE	100		50
Total			100
Grading Consideration			50% CIE + 50% SEE

2. Evaluation of IPCC Courses

Assessment	Actual Weightage in Marks		Final weightage in Marks
CIE 1	50		Average of 2 CIEs out of 25
CIE 2	50		
AAT	No. of AATs planned	Marks	10
	1	10	
	2	05 + 05	
LAB	Continuous Lab Evaluation	10	15
	Lab Assessment	05 + 10 + 05 = 20	
	Writeup + Execution + Viva Voce		
SEE	100		50
Total			100
Grading Consideration	Head of Department Computer Science Engineering		50% CIE + 50% SEE



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3. Evaluation of PCCL / AEC Courses

Assessment	Actual Weightage in Marks	Final weightage in Marks
Continuous Weekly Evaluation	Writeup + Execution + Viva $05 + 03 + 02 = 10$	10
Lab CIE 1 (After 1st Cycle of Experiments)	Writeup + Execution + Viva $05 + 10 + 05 = 20$ Scaled down to 10	10
Lab CIE 2 (After 2nd Cycle of Experiments)	Writeup + Execution + Viva $05 + 10 + 05 = 20$ Scaled down to 10	10
Final Lab CIE (All Experiments)	Writeup + Execution + Viva $15 + 70 + 15 = 100$ Scaled down to 20	20
SEE	100	50
Total		100
Grading Consideration		50% CIE + 50% SEE



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Department: Mathematics		
Semester: III	Course Code: BMATS24301	Contact Hrs /week: 03
Course Title: Discrete Mathematics (Common for CSE/ISE/AI&DS/AI & ML/CS-AI&ML)		No. of Credits: 3 L : T : P : S = 3:0:0:0
Course Category: Basic Science Course (BSC)		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50	Exam Hours: 03
Course Pre-requisites: Basic algebra and number theory Fundamental concepts of functions and relations Introductory set theory and probability concepts from high school mathematics		

1. PREAMBLE ABOUT THE COURSE

This course provides a foundation in discrete mathematical structures that are vital to computer science, information technology, and applied mathematics. The course covers set theory, logic, counting principles, relations, functions, and probability with emphasis on reasoning, proof techniques, and combinatorial problem-solving. Through structured learning and problem-oriented approaches, students will build the mathematical foundation required for algorithm design, data structures, and theoretical computer science.

2. COURSE LEVEL OBJECTIVES

By the end of this course, students will be able to:

1. **Apply set theory and probability concepts.**
2. **Construct and evaluate logical statements.**
3. **Use counting principles and combinatorial techniques.**
4. **Analyze and classify relations and functions.**
5. **Identify and manipulate different types of functions.**

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3. COURSE OUTCOMES (COs) & COMPETENCIES

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply set theory, counting principles, and basic probability concepts to model and solve problems in computer science, including algorithm analysis and data representation.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08
CO2	Construct and evaluate logical statements using truth tables, rules of inference, and quantifiers to develop valid proofs and verify program correctness.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08
CO3	Solve combinatorial problems using counting techniques, permutations, combinations, and mathematical induction to support algorithm design and complexity analysis.	PO1, PO2, PO5	L2	WK1, WK2, WK3, WK6	08
CO4	Analyze relations and their properties using matrices and graphs, and interpret equivalence and partial order relations using Hasse diagrams and partitions in discrete structures.	PO1, PO2, PO5	L4	WK1, WK2, WK3, WK6	08
CO5	Apply function theory, generating functions, and recurrence relations to model computational processes and analyze recursive algorithms.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Sets and Subsets, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams. Probability, Axioms of probability, Conditional probability, Bayes theorem.	CO1	08
II	Fundamentals of Logic: Basic Connectives and Truth Tables, Logic Equivalence, The Laws of Logic Logical Implication:	CO2	08

	Rules of Inference, Quantifiers, Definitions, and the Proofs of Theorems.		
III	Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations: The Binomial Theorem, Combinations with Repetition. The Well Ordering Principle: Mathematical Induction, Recursive Definitions.	CO3	08
IV	Relations: Cartesian Products and Relations, Properties of Relations, Computer Recognition: Zero-One Matrices and Directed Graphs, Partial Orders: Hasse Diagrams, Equivalence Relations and Partitions.	CO4	08
V	Functions: Plain and One-to-One, Onto Functions. Function Composition and Inverse Functions. Generating function and first order recurrence relation.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Discrete and Combinatorial Mathematics	Ralph P. Grimaldi	Pearson Education	5th
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44th
3	Discrete Mathematics and its Applications	Kenneth H. Rosen	McGraw Hill	6th
4	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th
5	Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks	T Veerarajan	Tata Mc-Graw Hill Co	4 th

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://swayam.gov.in/nptel/onlinecourses.nptel.ac.in/>
2. <https://academicearth.org/online-college-courses/>
3. <https://elearning.vtu.ac.in/>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	1	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-
CO3	3	1	-	-	1	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24302	Contact Hrs /week: 03
Course Description: Data Structures and Applications		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 04
Course Pre-requisites: C Programming		

1. PREAMBLE ABOUT THE COURSE

Data structures form the backbone of efficient algorithm design and effective software development. They provide a systematic way to organize, manage, and store data for optimal access and modification. The study of data structures is fundamental to computer science and engineering, as it enables the development of programs that are not only correct but also scalable and high-performing.

This course (or document) on Data Structures and Applications aims to introduce key concepts, including arrays, linked lists, stacks, queues, trees, graphs, and hash tables, along with their associated algorithms. Emphasis is placed on understanding the trade-offs in different data structures and their real-world applications in areas such as database systems, operating systems, compilers, artificial intelligence, and networking.

By mastering data structures, learners acquire the tools necessary to tackle complex computational problems, develop efficient software solutions, and lay the groundwork for advanced study in computer science.

2. COURSE LEVEL OBJECTIVES

CLO1	To provide the knowledge of basic data structures and their implementations
CLO2	To develop skills to apply appropriate data structures in problem solving
CLO3	To efficiently implement the different data structures and solutions for specific problems
CLO4	Create and use appropriate data structures in C programs for solving real life problems

3. COURSE OUTCOMES (COs) & COMPETENCIES

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After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Implement stacks, queues, linked lists and their applications.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply	WK1, WK2, WK4	22
CO2	Illustrate the construction and traversals of binary trees, binary search trees, balanced search trees, heaps and graphs.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply	WK1, WK2, WK4	12
CO3	Describe hashing functions, concepts of collision and its resolution methods.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply	WK1, WK2, WK4	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Introduction to Data Structures, Review of Arrays, Types of Data Structures, Linear & non-linear Data Structures. Stacks: Stack definitions & concepts, Representing stacks in C, Operations on stacks, Applications of Stacks: Infix to Postfix, Infix to Prefix, Postfix expression evaluation, Recursion: Sample Programs.	CO1	06
II	Queues: Representation of queue, operations, circular queues. Application of Queues, Priority Queues. Dynamic Memory allocation: malloc(), calloc(), free(), realloc(). Linked Lists: Definition and terminology, Singly Linked List (SLL) Various operations on SLL: insertion, deletion and display, Programming Examples Such as Polynomials and others., Header Node.	CO1	10
III	Circular Singly Linked List (CSLL): Definition, Various operations, Application. Doubly Linked List (DLL) Definition, Various operations Applications: Sparse matrix and others. Trees: Definition, Terminology, Binary Trees (BT)	CO1, CO2	10

	Binary Search Trees (BST): Insertion, Deletion and Traversals: Preorder, Post order and In order.		
IV	Expression Trees (ET): Definition and Construction of Expression Tree. Threaded Binary Tree: Types and application. Heap: Definition, Construction, Applications of Heap: Priority Queue.	CO2	08
V	Balanced tree: AVL trees, B tree. Graphs: Introduction, Matrix and List Representation. Hashing: Open Hashing, Closed Hashing, Collision and Collision Resolution Strategies.	CO2, CO3	08

List of Programs

Sl. No.	Program Description
1	Develop a menu driven Program for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX) a) Push an Element on to Stack b) Pop an Element from Stack c) Demonstrate Overflow and Underflow situations on Stack d) Display the status of Stack e) Exit Support the program with appropriate functions for each of the above operations
2	Develop a Program for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands
3	Develop and Implement a Program for evaluation of Stack Suffix expression with single digit operands and operators: +, -, *, /, %, ^.
4	Develop recursive program to a) Find GCD of 2 numbers b) Solve the Tower of Hanoi Problem
5	Develop a menu driven Program for the following operations on QUEUE of Characters (Array Implementation of QUEUE with maximum size MAX) a) Enqueue an Element on to Queue b) Dequeue an Element from Queue c) Demonstrate Overflow and Underflow situations on Queue d) Display the status of Queue e) Exit Support the program with appropriate functions for each of the above operations
6	Implement a program to multiply two polynomials using singly linked list.

7	Design a doubly linked list to represent sparse matrix. Each node in the list can have the row and column index of the matrix element and the value of the element. Print the complete matrix as the output.
8	Write a program to create Binary Tree and to traverse the tree using In-order, Preorder and Post order.
9	Write a program to implement priority queue using Heap.
10	Write a program to implement Hashing using Linear probing. Implement insertion, deletion, search and display.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Structures using C and C++	Yedidyah Langsam, Moshe J Augenstein, Aaron MTenenbaum,	Pearson	2 nd	All
2	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss	Pearson	4 th	All
3	Data Structures using C	Reema Thareja	Oxford Higher Education	1 st	All
4	Fundamentals of Data Structures	Ellis Horowitz, Sartaj Sahni,	Computer Science Press	4 th	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>
2. <https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html>
3. <https://archive.nptel.ac.in/courses/106/102/106102064/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	1	-	-	-	-	-	2
CO2	3	2	1	-	1	-	-	-	-	-	2
CO3	3	2	1	-	1	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24303	Contact Hrs /week: 03
Course Description: Digital Design and Computer Organization		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basic Electronics, Principles of C Programming		

1. PREAMBLE ABOUT THE COURSE

Digital Design and Computer Organization are fundamental disciplines in the field of computer science and engineering. Digital design focuses on the design and development of digital circuits and systems, while computer organization explores the internal structure and operation of computers. This course covers the principles and practices of digital design, including logic gates, combinational and sequential circuits, and computer architecture, including processor design, memory hierarchy, and input/output systems. Students will gain a deep understanding of the underlying hardware and software components that enable modern computing systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamentals of computer System, its organization and appreciate the functionalities of basic processing unit and its control system in processing the Instruction
CLO2	Develop a clear understanding on the Memory System and its design
CLO3	Optimize and design combinational and sequential circuits
CLO4	Experimentally validate the combinational and sequential circuits logic circuits

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Design various combinational Logic circuits	PO1, PO2, PO3, PO5	Apply	WK2, WK4, WK5, WK6	12
CO2	Demonstrate the models of Sequential circuits	PO1, PO2, PO3, PO5	Apply	WK2, WK4, WK5, WK6	10
CO3	Demonstrate basic functional units, instruction sequencing and various addressing modes	PO1, PO2, PO3, PO5, PSO2	Apply	WK2, WK4, WK5, WK6	14
CO4	Interpret the characteristics of various memory systems and I/O communication	PO1, PO2, PO3, PO5, PSO2	Understand	WK2, WK4	06

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Combinational Logic Circuits: The Map Method: Two, Three, Four Variable Maps, Map Manipulation, Product-Of-Sums, Sum-of-Products Optimization, Don't Care Conditions, The Tabulation Method, Binary Adders, Subtractors, Multiplexers. Flip-Flops and Applications: Introduction to Flip-Flops, Types of Flip flops, Various Representation of Flip-Flops, JK Master-slave Flip-Flop, Flip-Flops Turning.	CO1	12
II	Registers: Types of Registers. Serial In - Serial Out, Serial In - Parallel out. Parallel In Serial Out, Parallel In - Parallel Out, Applications of Shift Registers. Counters: Asynchronous Counters, Synchronous Counters, Counter Design as a Synthesis problem.	CO2	10
III	Basic Structure of Computers: Functional Units, Basic Operational Concepts, Arithmetic: Numbers, Arithmetic Operations and Characters, Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed Operand	CO3	09

	Multiplication, Fast Multiplication- Bit-pair recoding of multipliers, Integer Division.		
IV	Instruction Set Architecture: Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing Addressing Modes, Assembly Language: Assembler Directives, Assembly and Execution of Programs. Stacks, Subroutines- Subroutine Nesting and the Processor Stack.	CO3	05
V	The Memory System: Basic Concepts, Semiconductor RAM Memories, Cache Memories-Mapping Functions, Examples of Mapping Techniques, Basic Processing Unit: Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control.	CO4	06

Laboratory Component

Note: Hardware experiments to be conducted using logic trainer kits and simulation experiments to be conducted using open-source software like Logisim.

List of Experiments

Sl. No.	Experiment Description
PART A	
1	Design and implement Half Adder, Full Adder, Half Subtractor, Full Subtractor using Logic Gates. Also simulate their working.
2	Given a 4-variable logic expression, simplify it using appropriate technique and realize the simplified logic expression using 8:1 multiplexer IC.
3	Realize a J-K Master Slave flip-flop using NAND gates and verify its truth table.
4	Design and implement 4-bit Ring and Johnson Counters. Also simulate their working.
5	Design and implement mod-n ($n < 8$) synchronous up counter using JK flip-flop ICs and demonstrate its working.
6	Design and implement an asynchronous counter using decade counter IC to count up from 0 to n ($n \leq 9$).
PART B	
7	Design a 4-bit CPU by interfacing registers, an ALU and a memory chip incorporating the following features a) Implement minimum five instructions namely MOV, ADD, SUB, LOAD, STORE, AND, NOT, OR, RETURN, CALL etc. b) Assume minimum two General Purpose Registers (R1 and R2) excluding Special Purpose Registers like PC, PSW. c) Assume 8 bit address and 4 bit data path d) Adopt appropriate memory chip to be addressed by 8 bit address decoder e) Result to be displayed on 7-segment displays f) Design an ALU to execute above said instructions

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Fundamentals of Logic Design	Charles H. Roth, Larry L Kinney	Thomson	6 th	1, 2
2	Computer Organization	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	McGraw Hill Education India	5 th	3, 4
3	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	McGraw Hill Education India	6 th	5
4	Digital Systems Principles and Applications	Neal S Widmer, Greg Moss and Ronald J Tocci	Pearson	12 th	1, 2
5	Computer Organization & Architecture	William Stallings	Pearson	9 th	4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc21_ee39/preview
2. https://onlinecourses.nptel.ac.in/noc25_cs154/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	2	3	1	-	3	-	-	-	-	-	-
CO2	2	2	3	-	3	-	-	-	-	-	-
CO3	2	2	3	-	3	-	-	-	-	-	-
CO4	1	2	3	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	3
CO4	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24304	Contact Hrs /week: 03
Course Description: Operating Systems		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PCC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basic Mathematics, C programming		

1. PREAMBLE ABOUT THE COURSE

Operating Systems course introduces students to the core software that manages computer hardware and applications. It covers essential concepts like process scheduling, memory management, file systems, and I/O operations. preparing students for real-world system-level programming and laying the foundation for advanced computer science topics.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamentals of an Operating Systems and its structures, concept of processes and threads
CLO2	Understand the implement efficient Process scheduling mechanisms and software solutions for process synchronization
CLO3	Discuss Deadlock handling mechanism
CLO4	Understand Operations in Memory Management
CLO5	Study the Virtual memory and mass storage Concepts

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

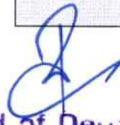
Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Discuss the basic concepts of operating systems, processes and threads	PO1, PO2, PO3, PO11, PSO1	Understand	WK2	08

CO2	Apply process management techniques, CPU scheduling algorithms, and synchronization tools to solve problems in operating systems	PO1, PO2, PO3, PO11, PSO1	Apply	WK4	10
CO3	Illustrate the different methods used for handling deadlocks in operating systems	PO1, PO2, PO3, PO11, PSO1	Apply	WK4	08
CO4	Interpret memory management mechanisms	PO1, PO2, PO3, PO11, PSO1	Apply	WK4	08
CO5	Illustrate Virtual memory concepts and mass storage structure	PO1, PO2, PO3, PO11, PSO1	Apply	WK2	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to operating System: What operating system do, Operating System Services, Systems Calls. Processes: Process Concepts, Process Scheduling, Inter Process Communication, Thread Overview, Multicore Programming, Multithreading Models.	CO1	08
II	Process Scheduling: CPU Scheduling - Basic concepts, Scheduling Criteria, Scheduling Algorithms. Process Synchronization: Background, Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores. Classic problems of Synchronization.	CO2	10
III	Deadlocks: System Model, Deadlock Characterization, Methods for Handling, Deadlocks, Deadlock Prevention. Deadlock Avoidance: Banker's Algorithm, Deadlock Detection and recovery from Deadlock.	CO3	08
IV	Memory management: Background, Contiguous memory allocation, paging, Structure of page table, Swapping.	CO4	08
V	Virtual memory management: Background, Demand Paging, Page Replacement algorithms: FIFO page replacement, Optimal page replacement, LRU page replacement. Thrashing: Cause of Thrashing.	CO5	08



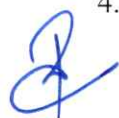
	Secondary Storage Structures: HDD Scheduling, Storage Device Management, RAID Structure-Redundancy, Parallelism, RAID levels, Selecting a RAID Level.		
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Operating System Principles	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne,	John Wiley & Sons, Inc.	10 th	All
2	Operating Systems: Internals and design principles	Stallings, William, Prentice Hall Press	Prentice Hall Press,	4 th	1, 2, 3, 4
3	Modern Operating Systems,	Andrew S Tanenbaum and Herbert Bos, Pearson	Pearson Education,	4 th	1, 2, 3, 4
4	Operating Systems: Principles and Practice	Thomas Anderson and Michael Dahlin	Recursive Books, 2014.	4 th	1, 2, 3, 4
5	Operating System Concepts	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley	Wiley India, 10th Edition, 2018.	10 th	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://training.linuxfoundation.org/training/introduction-to-linux/>
2. <https://www.edx.org/learn/operating-systems/ibm-hardware-and-operating-systems>
3. <http://www.nptel.ac.in/courses/106108101/>
4. <https://www.coursera.org/learn/os-power-user>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	3	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	3	-	-	-	-	-	-	-	3
CO4	3	3	3	-	-	-	-	-	-	-	3
CO5	3	3	3	-	-	-	-	-	-	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: III	Course Code: BCSL24305	Contact Hrs /week: 02
Course Description: Unix Shell Programming		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: PCCL		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Knowledge of Operating Systems		

1. PREAMBLE ABOUT THE COURSE

This course in Unix Shell Programming is designed with knowledge of operating systems. It introduces the basics of the Unix operating system, commands, command-line interface, and shell scripting in a structured and beginner-friendly manner. Students will learn how to interact with the Unix shell, write simple scripts, manage files and directories, and automate routine tasks. Emphasis is placed on hands-on practice to build a solid foundation and develop problem-solving skills in a Unix/Linux environment. By the end of the course, students will be equipped with the essential tools and understanding to confidently use shell scripting for academic and practical applications in computer science and related fields.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the features and architecture of UNIX with basic commands.
CLO2	Apply the knowledge of Unix commands through Unix shell script programming
CLO3	Develop shell scripts to automate tasks, perform system operations, and implement basic logic using control structures.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply knowledge of UNIX features and architecture to execute basic commands effectively	PO1, PO5, PSO1	Apply	WK6, WK8	09

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CO2	Apply the knowledge of <i>Unix</i> commands through <i>Unix</i> shell script programming	PO1, PO2, PO5, PSO1	Apply	WK6, WK8	09
CO3	Develop shell scripts to automate tasks, perform system operations, and implement basic logic using control structures.	PO1, PO3, PO4, PO5, PO8, PO9, PO10, PO11, PSO1	Create	WK6, WK8	10

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	Topics: <i>UNIX</i> architecture, kernel & shell, Types of shells (Bourne, C, Korn, Bash), Basic <i>UNIX</i> commands: ls, pwd, cd, touch, echo To practice on <i>UNIX</i> commands: man, echo, passwd, uname, who, date, cal, banner, tty, pwd, cd, ls, cat, touch, clear, more, wc.	CO1, CO2	02
2	Topics: To practice <i>UNIX</i> commands on Editor. Writing a shell script.	CO1, CO2	02
3	Topics: File handling in <i>UNIX</i> : mkdir, rmdir, cat, cp, mv, Lab Program: - Write a shell script to display the current working directory, list all files and display current date and time. - Write a shell script to create a directory, create a file in it and copy the file to another directory.	CO1, CO2	02
4	Topics: File types and permissions, chmod, chown, chgrp, umask, File viewing commands: cat, more, less, head, tail Lab Program: - Write a shell script that accepts two file names as arguments, checks if the permissions for these files are identical and if the permission are identical, output common - permission and otherwise output each file name followed by its permissions.	CO1, CO2, CO3	02

	c) Shell script to count the number of files and directories in a given path.		
5	Topics: Variables and quoting, Read, command-line arguments \$0, \$1, etc Lab Program: a) Shell script to accept a name from user and greet them with a message. b) Shell script to add two numbers passed as command-line arguments	CO1, CO2, CO3	02
6	Topics: if, if-else, if-elif-else, test and [] expressions Lab Program: a) Shell script to check if a number is even or odd. b) Shell script to check whether a file exists and is readable/writable/executable.	CO1, CO2, CO3	02
7	Topics: While, until, for loops, break, continue Lab Program: a) Shell script to print the multiplication table of a given number. b) Shell script to find factorial of a number using a while loop.	CO1, CO2, CO3	02
8	Topics: Case statement, Menu-driven programs Lab Program: a) Shell script to perform basic arithmetic operations using case. b) Shell script for a menu-driven program to list files, view current directory, and exit.	CO1, CO2, CO3	02
9	Topics: String manipulation: length, substring, comparison, File input/output redirection Lab Program: a) Shell script to check whether a string is a palindrome. b) Shell script to count number of lines, words, and characters in a file.	CO1, CO2, CO3	02
10	Topics: String manipulation: length, substring, comparison, File input/output redirection Lab Program:	CO1, CO2, CO3	02



	a) Shell script to check whether a string is a palindrome. b) Shell script to count number of lines, words, and characters in a file.		
11	Topics: grep, cut, sort, uniq, tr, Using pipes () and redirection Lab Program: a) Shell script to extract usernames from /etc/passwd using grep. b) Shell script to remove duplicate lines from a file using sort and uniq.	CO1, CO2, CO3	02
12	Topics: Shell scripts a) Write a shell script that accepts one or more filenames as argument and convert all of them to uppercase, provided they exist in current directory. b) Write a shell script that displays all the links to a file specified as the first argument to the script. The second argument, which is optional, can be used to specify in which the search is to begin. If this second argument is not present, the search is to begin in current working directory. In either case, the starting directory as well as all its subdirectories at all levels must be searched. The script need not c) include any error checking.	CO1, CO2, CO3	02
13	Experimental Practices.	CO1, CO2, CO3	02
14	Continuous Internal Evaluation.	CO1, CO2, CO3	02

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	UNIX Concepts and Applications	Sumitabha Das	Tata McGraw Hill	4 th	1
2	UNIX & Shell Programming	M.G.Venkatesh Murthy	Pearson Education.	Second Impression	2

3	Linux Command Line and Shell Scripting Bible	Richard Blum, Christine Bresnahan	Wiley, 2014	2 nd	3
4	The Complete Reference UNIX	Kenneth Rosen, Douglas Host, Rachel Klee, James Farber, Richard Rosinski	Tata McGRAW-HILL Edition	2 nd Edition, 6th Reprint	4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://nptel.ac.in/courses/117106113>
2. <https://infyspringboard.onwingspan.com/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-
CO3	3	-	3	1	3	-	-	2	2	1	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24306A	Contact Hrs /week: 40
Course Description: Programming with Julia		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of any Programming Language		

1. PREAMBLE ABOUT THE COURSE

Julia is a high-level, high-performance, and dynamic programming language designed for numerical and scientific computing. Created with the goals of speed, simplicity, and scalability, Julia combines the ease of use of languages like Python with the execution speed of C and Fortran. It supports multiple programming paradigms including procedural, functional, and object-oriented styles, making it versatile for various applications. Julia is particularly well-suited for data science, machine learning, computational science, and large-scale linear algebra, thanks to its powerful type system and just-in-time (JIT) compilation using LLVM. With a growing ecosystem and strong community support, Julia stands as a modern language for researchers, engineers, and developers aiming for both productivity and performance.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the basics of Julia programming language
CLO2	To illustrate the data structures of Julia programming language
CLO3	To make use of built-in functions and packages

3. COURSE OUTCOMES (COs) & COMPETENCIES

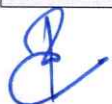
After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the basic structure of Julia programs to write scripts using variables, operators, and string manipulations.	PO1, PO5	Apply	WK2, WK4, WK6	06
CO2	Apply functions and recursion constructs to solve computational problems using Julia.	PO1, PO5	Apply	WK2, WK4, WK6	08
CO3	Develop iterative solutions and string-handling routines using loops and string operations in Julia.	PO1, PO5	Apply	WK2, WK4, WK6	08
CO4	Design modular programs with reusable functions and structured interface components using Julia.	PO1, PO2, PO3, PO5, PSO1	Create	WK2, WK4, WK6	10
CO5	Implement data-handling operations with arrays and file systems, including exception handling and persistence.	PO1, PO2, PO5	Analyze	WK2, WK4, WK6	10

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	The Way of the Program: Running Julia, The First Program, Arithmetic Operators, Values and Types. Variables, Expressions and Statements: Assignment Statements, Variable Names, Expressions and Statements, Script Mode, Operator Precedence, String Operations.	CO1	06
II	Functions: Function Calls, Math Functions, Composition, Adding New Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters Are Local, Stack Diagrams, Fruitful Functions and Void Functions.	CO2	08



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	Conditionals and Recursion: Floor Division and Modulus, Boolean Expressions, Logical Operators, Conditional Execution, Alternative Execution, Chained Conditionals, Nested Conditionals, Recursion.		
III	Iteration: Reassignment, Updating Variables, The while Statement, break, continue, Square Roots. Strings: Characters, A String Is a Sequence, length, Traversal String Slices, Strings Are Immutable, String Interpolation, Searching, Looping and Counting, String Library, The $\in$ Operator, String Comparison.	CO3	08
IV	Interface Design: Turtles, Simple Repetition, Exercises, Encapsulation, Generalization, Interface Design, Refactoring, A Development Plan, Docstring, Debugging	CO4	10
V	Arrays: An Array is a Sequence, Arrays Are Mutable, Traversing an Array, Array Slices, Array Library, Map, Filter and Reduce, Dot Syntax, Deleting (Inserting) Elements, Arrays and Strings, Objects and Values, Aliasing, Array Arguments. Files: Persistence, Reading and Writing, Formatting, Filenames and Paths, Catching Exceptions, Databases, Serialization, Command Objects, Modules.	CO5	10

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Think Julia: How to Think Like a Computer Scientist	Ben Lauwens, Allen Downey	O'reilly	1 st	All
2	Mastering Julia 1.0	Malcolm Sherrington	Packt	1 st	All
3	Beginning Julia Programming : For Engineers and Scientists	Sandeep Nagar	Apress	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. https://benlauwens.github.io/ThinkJulia.jl/latest/book.html#_modules
2. https://books.google.co.in/books?id=UISQDwAAQBAJ&printsec=copyright&redir_esc=y#v=onepage&q&f=false

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	1	-	-	-	-	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-
CO3	3	-	-	-	1	-	-	-	-	-	-
CO4	2	3	1	-	1	-	-	-	-	-	-
CO5	2	3	-	-	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	2	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24306B	Contact Hrs /week: 03
Course Description: Object Oriented Programming with C++		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C Programming, Python		

1. PREAMBLE ABOUT THE COURSE

This course provides a comprehensive introduction to C++ with a strong emphasis on Object-Oriented Programming. Students will explore key concepts such as classes, objects, constructors, destructors, function and operator overloading, and inheritance. Advanced topics include pointers, dynamic memory allocation, polymorphism, templates, and exception handling to build efficient and reusable code. The course also covers C++ I/O operations and file handling to prepare students for real-world programming tasks.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamentals of object-oriented programming and the structure of a C++ program, including the use of classes, objects, constructors, and destructors
CLO2	Apply concepts of arrays, pointers, references, and dynamic memory management to manipulate object data and support efficient memory usage in C++
CLO3	Develop programs using function and operator overloading, friend functions, and inheritance to implement reusable and extensible code
CLO4	Implement polymorphism using virtual functions and manage function binding across class hierarchies
CLO5	Utilize templates, exception handling, and file I/O operations to build flexible, error-resilient, and real-world C++ applications

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Demonstrate the understanding of Object-Oriented Programming principles such as encapsulation, inheritance, polymorphism, and abstraction using C++ classes and objects	PO1, PO2, PO3, PO5, PSO1	Apply	WK2, WK3, WK6	08
CO2	Apply arrays, pointers, references, and dynamic memory allocation to manage objects and class members in object-oriented programming	PO1, PO2, PO3, PO5, PSO1	Apply	WK2, WK3, WK6	08
CO3	Demonstrate the ability to implement Operator Overloading using member and friend functions, including overloading of dynamic memory operators	PO1, PO2, PO3, PO5, PSO1	Apply	WK2, WK3, WK6	08
CO4	Demonstrate the use of virtual functions and polymorphism to implement dynamic behaviour in class hierarchies, including the use of pure virtual functions and understanding binding mechanisms	PO1, PO2, PO3, PO5, PSO1	Apply	WK2, WK3, WK6	08
CO5	Apply the principles of exception handling in C++ to manage runtime errors effectively, including handling derived-class exceptions and exploring various file handling strategies	PO1, PO2, PO3, PO5, PSO1	Apply	WK2, WK3, WK6	10

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9


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4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	An overview of C++: What is object-Oriented Programming? Introducing C++ Classes, The General Form of a C++ Program. Classes and Objects: Classes, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, The Scope Resolution Operator, Passing Objects to functions, Returning Objects, Object Assignment.	CO1	08
II	Arrays, Pointers, References, and the Dynamic Allocation Operators: Arrays of Objects, Pointers to Objects, The this Pointer, Pointers to derived types, Pointers to class members. Functions Overloading, Copy Constructors: Functions Overloading, Overloading Constructor Functions. Copy Constructors, Default Function Arguments, Function Overloading and Ambiguity.	CO2	08
III	Operator Overloading: Creating a Member Operator Function, Operator Overloading Using a Friend Function, Overloading new and delete Inheritance: Base-Class Access Control, Inheritance and Protected Members, Inheriting Multiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes	CO3	08
IV	Virtual Functions and Polymorphism: Virtual Functions, The Virtual Attribute is Inherited, Virtual Functions are Hierarchical, Pure Virtual Functions, Using Virtual Functions, Early vs Late Binding. Templates: Generic Functions, Applying Generic Functions, Generic Classes. The type name and export Keywords. The Power of Templates	CO4	08
V	Exception Handling: Exception Handling Fundamentals, Handling Derived-Class Exceptions, Exception Handling Options, Applying Exception Handling. The C++ I/O System Basics: C++ Streams, The C++ Classes, Formatted I/O File I/O: and File Classes, Opening and Closing a File, Reading and Writing Text Files, Detecting EOF	CO5	10



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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The Complete Reference C++	Herbert Schildt,	Tata McGraw Hill Education Pvt.Ltd	4 th	All
2	Object Oriented Programming with C++	Balagurusamy E	Tata McGraw Hill Education Pvt. Ltd	6 th	All
3	Object Oriented Programming with C++	Bhave	Pearson Education	2 nd	All
4	Object Oriented Programming with C++	A K Sharma	Pearson Education	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://tfetimes.com/wp-content/uploads/2015/04/progcpp.pdf>
2. <https://tfetimes.com/wp-content/uploads/2015/04/structured-programming-with-c-plus-plus.pdf>
3. <https://tfetimes.com/wp-content/uploads/2015/04/c-for-c-programmers.pdf>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	-	1	-	-	-	-	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-
CO3	2	1	1	-	1	-	-	-	-	-	-
CO4	2	1	1	-	1	-	-	-	-	-	-
CO5	2	1	1	-	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24306C	Contact Hrs /week: 03
Course Description: Cyber Security		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: NIL		

1. PREAMBLE ABOUT THE COURSE

Cybersecurity is crucial for students because it protects their personal information, learning environment, and well-being in the digital age. It helps prevent cyberbullying, data breaches, and identity theft, while also fostering digital literacy and responsible online behaviour. In essence, cybersecurity is not just about protecting data; it's about creating a safe, secure, and empowering learning environment for students in the increasingly digital world.

2. COURSE LEVEL OBJECTIVES

CLO1	To familiarize cybercrime terminologies and perspectives
CLO2	To understand Cyber Offenses and Botnets
CLO3	To gain knowledge on tools and methods used in cybercrimes
CLO4	To understand phishing and computer forensics

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the cybercrime terminologies	PO1, PO11, PSO1	Understand	WK2, WK4, WK7	08
CO2	Describe Cyber offenses and Botnets	PO1, PO11, PSO1	Understand	WK2, WK4, WK7	08

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CO3	Discuss Tools and Methods used on Cybercrime	PO1, PO5, PO11, PSO1	Understand	WK2, WK4 , WK7	08
CO4	Interpret Phishing and Identity Theft	PO1, PO5, PO11, PSO1	Understand	WK2, WK4 , WK7	10
CO5	Summarize the need of computer forensics	PO1, PO5, PO11, PSO1	Understand	WK2, WK4 , WK7	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives	CO1	08
II	Cyber Offenses: How Criminals Plan Them: Introduction, How criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercafé & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector	CO2	08
III	Tools and Methods used in Cybercrime: Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDOS Attackers, Attacks on Wireless networks.	CO3	08
IV	Phishing and Identity Theft: Introduction, methods of phishing, phishing techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft.	CO4	10
V	Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics.	CO5	08



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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives	Sunit Belapure and Nina Godbole	Wiley India Pvt Ltd	First Edition (Reprinted 2018)	All
2	Internet Security Fundamentals	nick ioannou	Tata Mc Graw Hill	10 th Anniversary Edition	2, 5
3	Managing Cybersecurity Risk: Cases Studies and Solutions Paperback	Jonathan Reuvid	Wiley India Pvt Ltd	2018	3, 4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. https://www.youtube.com/watch?v=yC_hFm0BX28&list=PLxApjaSnQGi6Jm7LLSxvmNQjS_rt9susu
2. <https://www.youtube.com/watch?v=KqSqyKwVuA8>
3. <https://www.cyberdegrees.org/resources/free-online-courses/>
4. <https://www.my-mooc.com/en/categorie/cybersecurity>
5. <https://www.coursera.org/courses?query=cybersecurity>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	-	-	2
CO2	2	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	1	-	-	-	-	-	2
CO4	2	-	-	-	1	-	-	-	-	-	2
CO5	2	-	-	-	1	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24306D	Contact Hrs /week: 03
Course Description: Robotic Process Automation		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basic Programming Knowledge		

1. PREAMBLE ABOUT THE COURSE

In an era driven by digital transformation, Robotic Process Automation (RPA) emerges as a powerful technology that enables the automation of repetitive, rule-based tasks using software bots. This course aims to equip students with the knowledge and skills to understand, design, and implement RPA solutions that enhance operational efficiency and reduce human error. By bridging the gap between business processes and emerging technologies, the course fosters innovation and prepares learners for the evolving demands of the modern workforce.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand basic concepts of RPA
CLO2	To describe IIPA, where it can be applied and how it implemented
CLO3	To describe the different types of variables, Control Flow and data manipulation techniques
CLO4	To understand Image, Text and data Tables Automation
CLO5	To describe various types of Exceptions and strategies to handle

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the basic concepts of RPA	PO1, PO2, PO6, PO11, PSO2	Understand	WK4	08

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CO2	Describe various components and platforms of RPA	PO1, PO2, PO6, PO11, PSO2	Understand	WK4	08
CO3	Illustrate control flow and data manipulation techniques	PO1, PO2, PO6, PO11, PSO2	Apply	WK4	10
CO4	Demonstrate control techniques and OCR techniques	PO1, PO2, PO6, PO11, PSO2	Understand	WK4	08
CO5	Describe various types of exceptions and debugging techniques	PO1, PO2, PO6, PO11, PSO2	Understand	WK4	08

WKS are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	RPA Foundations: What is RPA - flavors of RPA- history of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI- Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 Devops- Flowcharts.	CO1	08
II	RPA Platforms Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio - Learning Ui Path Studio- - Task recorder - Step-by step examples using the recorder.	CO2	08
III	Sequence, Flowchart, and Control Flow: Sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope Collections- Arguments - Purpose and use-Data table usage with examples Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).	CO3	10
IV	Taking Control of the Controls: Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls - mouse and keyboard activities-	CO4	08

	Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.		
V	Exception handling, Debugging, and Logging: Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The Robotic Process Automation Handbook	Tom I'aulli	A press	1 st	1, 2, 4
2	Learning Robotic Process Automation	AlokMani Tripathi	Packt Publishing	1 st	2, 3, 4, 5
3	Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation	SrikanthMeri anda	CreateSpace Independent	1 st	1, 4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://www.coursera.org/courses?query=robotic%20process%20automation>
2. <https://www.edx.org/learn/robotic-process-automation>
3. <https://www.udemy.com/topic/robotic-process-automation/>
4. <https://academy.uipath.com>
5. <https://university.automationanywhere.com>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	2	-	-	-	-	2
CO2	2	2	-	-	-	2	-	-	-	-	2
CO3	3	3	-	-	-	2	-	-	-	-	2
CO4	3	3	-	-	-	2	-	-	-	-	2
CO5	3	3	-	-	-	2	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High



8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Science & Humanities		
Semester: III	Course Code: BSCK24307	Contact Hrs /week: 02
Course Description: Social Connect & Responsibility		No. of Credits: 01 L : T : P : S = 0:0:2:1
Course Category: UHV		Total no. of Hours = 15
CIE: 100 Marks	SEE: -	Exam Hours: -

1. PREAMBLE ABOUT THE COURSE

The *Social Connect & Responsibility* course aims to nurture social awareness, civic responsibility, and environmental sensitivity among students. Through activities like tree plantation, heritage walks, organic farming, and community engagement, students gain hands-on experience in understanding societal needs and contributing to sustainable solutions. The course fosters empathy, teamwork, and leadership, encouraging students to connect classroom learning with real-world impact.

2. COURSE LEVEL OBJECTIVES

CLO1	Provide a formal platform for students to communicate and connect to the surrounding.
CLO2	Create a responsible connection with the society.
CLO3	Understand the community in general in which they work.
CLO4	Identify the needs and problems of the community and involve them in problem – solving.
CLO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Communicate and connect to the surrounding.
CO2	Create a responsible connection with the society.
CO3	Involve in the community in general in which they work.
CO4	Notice the needs and problems of the community and involve them in problem –solving.
CO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description
I	Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.
II	Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.
III	Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus – Objectives, Visit, case study, report, outcomes.
IV	Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.
V	Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24358A	Contact Hrs /week: 14
Course Description: Data Analytics with Excel		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of MS-Excel		

1. PREAMBLE ABOUT THE COURSE

In the era of data-driven decision making, the ability to analyze and interpret data is a critical skill across all disciplines. Microsoft Excel remains one of the most widely used tools for data analysis due to its accessibility, flexibility, and powerful built-in features. This course introduces students to the fundamentals of data analytics using Excel, focusing on data organization, cleaning, visualization, and statistical analysis.

Students will learn how to leverage Excel functions, pivot tables, charts, and advanced tools like Power Query and Power Pivot to extract meaningful insights from raw data. Emphasis is placed on practical, hands-on experience that prepares learners to apply analytical techniques to real-world scenarios. By the end of the course, students will be equipped to make informed decisions, create compelling data visualizations, and support business intelligence tasks using Excel as a primary tool.

2. COURSE LEVEL OBJECTIVES

CLO1	To Apply analysis techniques to datasets in Excel
CLO2	Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
CLO3	Understand and identify the principles of data analysis
CLO4	Become adept at using Excel functions and techniques for analysis
CLO5	Build presentation ready dashboards in Excel


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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Develop worksheets using aggregate, filter functions, and pivot table	PO1, PO2, PO3, PO5, PSO1	Create	WK1, WK2, WK6	08
CO2	Practice Conditional Formatting, What-If Analysis, data cleaning tasks on excel sheets	PO1, PO5	Apply	WK1, WK2, WK6	08
CO3	Construct excel workbook with linked worksheets, accurate cross-sheet calculations, and a visually clear summary report.	PO1, PO2, PO3, PO5, PSO1	Create	WK1, WK2, WK6	04
CO4	Apply Macros and Autofilter to solve the given real world scenario	PO1, PO5	Apply	WK1, WK2, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours
1	Create a spreadsheet to maintain the marks of students in five subjects. Perform the following tasks: - Create a spreadsheet with the following columns: Student ID, Name, Subject 1, Subject 2, Subject 3, Subject 4, Subject 5. - Enter data for at least 10 students using the drag & fill feature wherever applicable (e.g., Student ID). - Insert a new row at the top to provide a title: "Student Marks Report" and merge the cells across the column range. - Insert a new column after Name titled "Total Marks", and calculate the total marks using the SUM function. - Add another column "Average Marks" and compute the average using the AVERAGE function. - Use aggregate functions such as: - MAX() to find the highest total mark.	CO1	04

	• MIN() to find the lowest total mark. • COUNT() to count the number of students. • AVERAGE() to compute the class average. g) Format the table for better readability (bold headers, cell borders, appropriate number formatting).		
2	You are provided with a CSV file containing sales data for a retail store. The dataset includes the following columns: Date, Product ID, Product Name, Category, Quantity Sold, Unit Price, and Region. - Import the provided CSV file into an Excel worksheet. - Add a new column named Total Sales and calculate the total sales for each row (Quantity Sold * Unit Price). - Correct any missing or incorrect entries in the Category and Region columns. - Insert 5 new rows of sample data relevant to the existing dataset. - Use appropriate cell formatting (currency, date, etc.) where necessary. - Sort the data by Region and then by Total Sales in descending order. - Apply filters to display: • Sales from a specific category (e.g., "Electronics"). • Sales greater than a specific amount (e.g., Total Sales > 5000). • Products sold in a specific region (e.g., "South").	CO1	04
3	You are provided with a dataset containing monthly sales information of a company. The dataset includes the following columns: Date, Region, Salesperson, Product Category, Units Sold, Unit Price, Total Sales - Apply data validation to ensure: • The "Region" column only accepts values from a predefined list (e.g., North, South, East, West). • The "Units Sold" column accepts only positive integers. • The "Product Category" column is selected from a dropdown list of allowed categories (e.g., Electronics, Furniture, Clothing, etc.). - Create a Pivot Table to analyze: • Total Sales by Region. • Total Sales by Product Category and Salesperson. • Average Units Sold per Region. - Generate Pivot Charts based on the pivot tables: • A bar chart showing total sales per region.	CO2	04

	A pie chart showing the percentage of sales per product category.		
4	You are provided with the quarterly sales data for a retail company across different regions. Using MS Excel, perform the following tasks: a) Create the Dataset: - Enter quarterly sales data for 4 products across 4 regions (North, South, East, West) over a year (Q1 to Q4). - Include columns for: Product Name, Region, Q1 Sales, Q2 Sales, Q3 Sales, Q4 Sales, and Total Sales. b) Apply Conditional Formatting: - Highlight the cells where sales in any quarter are below a threshold (e.g., \$5,000). - Use a color scale to visually represent the Total Sales column (low to high). c) Perform What-If Analysis: - Use Goal Seek to determine the required Q4 sales to achieve a specific Total Sales goal for a product. - Use Scenario Manager to evaluate different pricing or discount scenarios and their effect on total revenue. d) Create a One-Variable Data Table: - Analyze how changes in Q4 sales affect the Total Sales for a specific product. - Use a column of varying Q4 values and link the formula to calculate the Total Sales. e) Visualize the Data: - Create a Column Chart to compare Total Sales across products. - Create a Pie Chart to show regional sales distribution. - Insert a Line Graph showing quarterly trends for one product.	CO2	02

5

You are given a dataset containing a list of employee details with inconsistent formatting. The columns include First Name, Last Name and Department. Perform the following data cleaning tasks:

- Convert all first names to uppercase.
- Convert all last names to lowercase.
- Remove leading and trailing spaces from all department names using the TRIM function.
- Create a full name column by concatenating the cleaned first and last names with a space in between.

Instructions:

- Use the UPPER() function to convert text to uppercase.
- Use the LOWER() function to convert text to lowercase.
- Use the TRIM() function to remove extra spaces from text.
- Use CONCATENATE() or TEXTJOIN() or & to combine first and last names into a full name.
- Format the data to ensure consistency and readability.

Sample Data (Before Cleaning):

First Name	Last Name	Department
John	DOE	sales
MARY	smith	HR
aLex	bROWN	it support

Expected Output (After Cleaning):

First Name (Upper)	Last Name (Lower)	Cleaned Department	Full Name
JOHN	doe	sales	JOHN doe
MARY	smith	HR	MARY smith
ALEX	brown	it support	ALEX brown

CO3

02


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6	You are given a dataset containing the following columns: <table><tr><th>Event Name</th><th>Start Date (Text)</th><th>End Date (Text)</th><th>Start Time (Text)</th></tr><tr><td>Event A</td><td>"01-Jan-2024"</td><td>"15-Jan-2024"</td><td>"09:30 AM"</td></tr><tr><td>Event B</td><td>"10-Feb-2024"</td><td>"25-Feb-2024"</td><td>"02:00 PM"</td></tr><tr><td>Event C</td><td>"05-Mar-2024"</td><td>"20-Mar-2024"</td><td>"11:15 AM"</td></tr></table> • Convert the Start Date and End Date to Excel-recognized date format using DATEVALUE. • Calculate the duration of each event in days using the DATEDIF function. • Add 7 days to each Start Date to find the "Follow-Up Date" using a formula equivalent to DATEADD. • Convert the Start Time to a time serial number using the TIMEVALUE function. • Format the converted values appropriately and display the results in new columns. Expected Output Table: <table><tr><th>Event Name</th><th>Start Date</th><th>End Date</th><th>Start Time</th><th>Start Date (Excel)</th><th>End Date (Excel)</th><th>Duration (Days)</th><th>Follow-Up Date</th><th>Start Time (Excel)</th></tr><tr><td>Event A</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr><tr><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td><td>...</td></tr></table>	Event Name	Start Date (Text)	End Date (Text)	Start Time (Text)	Event A	"01-Jan-2024"	"15-Jan-2024"	"09:30 AM"	Event B	"10-Feb-2024"	"25-Feb-2024"	"02:00 PM"	Event C	"05-Mar-2024"	"20-Mar-2024"	"11:15 AM"	Event Name	Start Date	End Date	Start Time	Start Date (Excel)	End Date (Excel)	Duration (Days)	Follow-Up Date	Start Time (Excel)	Event A	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	CO3	02
	Event Name	Start Date (Text)	End Date (Text)	Start Time (Text)																																										
	Event A	"01-Jan-2024"	"15-Jan-2024"	"09:30 AM"																																										
	Event B	"10-Feb-2024"	"25-Feb-2024"	"02:00 PM"																																										
	Event C	"05-Mar-2024"	"20-Mar-2024"	"11:15 AM"																																										
Event Name	Start Date	End Date	Start Time	Start Date (Excel)	End Date (Excel)	Duration (Days)	Follow-Up Date	Start Time (Excel)																																						
Event A	...	...	...	...	...	...	...	...																																						
...	...	...	...	...	...	...	...	...																																						
7	You are provided with a dataset containing customer information including Name, Date of Birth, Email, Purchase Amount, and Purchase Date. The data is unformatted and contains mixed information in single cells. Your task is to: a) Format the spreadsheet for better readability: • Apply suitable number formats (currency, date, percentage). • Use cell styles, font adjustments, borders, and alignment. • Use Freeze Panes and Column Width adjustment for clarity. b) Parse the data using text functions: • Extract first and last names from a full name column. • Separate date into day, month, and year. • Extract domain names from email addresses using TEXT, LEFT, RIGHT, MID, FIND, and LEN functions.	CO3	02																																											

	c) Highlight the data using Conditional Formatting: - Highlight customers whose Purchase Amount is above a specific threshold (e.g., > ₹10,000). - Use data bars or color scales to visually represent purchase amounts. - Highlight duplicate email entries, if any.		
8	You are given sales data for a company across three different regions – North, South, and West – for four quarters. Each region's data is stored in a separate worksheet within the same workbook. Your task is to: - Create three worksheets named North, South, and West. - In each worksheet, enter sales data for Quarter 1 to Quarter 4 for 5 different products. - Create a fourth worksheet named Summary that: - Calculates the total annual sales for each product across all regions using cross-sheet formulas. - Identifies the region with the highest total sales. - Displays the average sales per quarter for each product across all regions. Instructions: - Use appropriate cell references across sheets (e.g., 'North'!B2) to perform cross-sheet calculations. - Use functions like SUM, AVERAGE, MAX, and IF where applicable. - Format the summary sheet with clear headings, borders, and conditional formatting to highlight key values (e.g., highest sales). Expected Outcome: A professionally organized Excel workbook with linked worksheets, accurate cross-sheet calculations, and a visually clear summary report.	CO3	02

9	Create an Excel worksheet with the following fields: Empno (Employee Number), Ename (Employee Name), Basic Pay (BP), Travelling Allowance (TA), Dearness Allowance (DA), House Rent Allowance (HRA), Income Tax (IT), Provident Fund (PF), Net Pay (NP) Instructions: - Input Data: Enter sample data for at least 5 employees including Empno, Ename, and Basic Pay (BP). - Apply the following formulae: - TA = 10% of Basic Pay - DA = 20% of Basic Pay - HRA = 15% of Basic Pay - IT = 5% of Gross Pay (where Gross Pay = BP + TA + DA + HRA) - PF = 12% of Basic Pay - Net Pay = Gross Pay – (IT + PF) - Use cell referencing and functions to calculate all fields accurately. - Data Analysis and Visualization: - Create a chart (Column or Bar Chart) to compare Net Pay across employees. - Use Conditional Formatting to highlight high and low net pay values. - Insert a Pivot Table to summarize total allowances or deductions per employee. - Documentation: - Include headings, borders, and cell formatting for better readability. - Add a short summary or interpretation of the chart (using a text box or notes).	CO4	02
10	Create a worksheet in MS Excel to manage inventory with the following columns: Product Code, Product Name, Product Type, MRP (Maximum Retail Price), Discount (%), Cost After Discount (<i>Calculated using appropriate formula</i>), Date of Purchase Instructions: - Data Entry: - Enter a minimum of 10 product records with varied types, prices, and discount rates. - Ensure that data types are consistent (e.g., date format for Date of Purchase).	CO4	02

	b) Formulas: • Use a formula to calculate Cost After Discount using: $\text{Cost} = \text{MRP} - (\text{MRP} * \text{Discount}\%)$ • Format the Cost and MRP columns to display currency values. c) Data Analysis: • Use Pivot Table to summarize total inventory value by Product Type. • Use COUNTIF or SUMIF functions to analyze stock or sales patterns (optional based on data scope). d) Visualization: • Create at least one chart (e.g., Bar Chart or Pie Chart) to visualize: ▪ Product distribution by type ▪ Comparison of MRP vs. Cost after discount e) Reporting: • Use Data Filters to sort and filter the inventory based on date, type, or discount. • Provide a short summary below the table highlighting key insights (e.g., highest discount, most expensive product, etc.).		
11	Create a worksheet in MS Excel for Sales Analysis of a Merchandise Store using the following dataset attributes: Order ID, Customer ID, Gender, Age, Date of Order, Month, Online Platform, Category of Product, Size, Quantity, Amount, Shipping City (Include any additional relevant details) Tasks to Perform: a) Data Entry and Formatting • Enter the sample sales data in tabular form. • Format the data appropriately (e.g., date formats, currency formats, cell styles). b) Data Analysis using Formulas • Use Excel formulas (e.g., IF, VLOOKUP, COUNTIF, SUMIF, TEXT, MONTH, etc.) to: ▪ Segregate data based on categories (e.g., Gender-wise or Category-wise sales). ▪ Calculate total revenue, average order value, and quantity sold. ▪ Extract the month from the date.	CO4	02

	c) Pivot Table Analysis - Create PivotTables to analyze: - Total sales per product category. - Monthly sales trends. - Sales performance across different online platforms or cities. - Age group-wise or gender-wise sales comparison. d) Data Visualization - Use charts (e.g., Column, Bar, Pie, Line, Combo charts) to: - Visualize comparative sales by category, gender, or month. - Show trends in quantity sold and revenue. - Represent platform-based or city-based distribution.		
12	You are given a dataset containing employee details including Employee ID, Name, Department, Designation, Salary, and Location. Perform the following tasks: a) Use AutoFilter to: - Display employees working in a specific department (e.g., "Sales"). - Filter employees whose salary is above a certain threshold (e.g., ₹50,000). - Combine multiple filter criteria (e.g., Department = "Marketing" and Location = "Delhi"). b) Generate a summary report based on filtered data: - Count the number of employees in each department using appropriate Excel functions. - Calculate the average salary for each filtered group. - Use conditional formatting to highlight salaries above average. c) Record a Macro to: - Automate the filtering process based on user-defined criteria. - Format the filtered data (e.g., apply bold headers, borders, and cell coloring). - Save the filtered data to a new worksheet named "Filtered Report". d) Present the report:	CO4	02

	- Create a summary chart (e.g., Bar or Pie chart) showing the number of employees by department. - Prepare a print-ready version of the report with headers, footers, and page setup formatting.		
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Analysis with Microsoft® Excel: Updated for Office 2007®	Berk & Carey	Cengage Learning	3 rd	All
2	Microsoft Excel 2019: Data Analysis And Business Modeling	Wayne L Winston	PHI	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- https://onlinecourses.nptel.ac.in/noc21_ge21/preview
- https://onlinecourses.swayam2.ac.in/imb24_mg56/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	-	3	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-
CO3	2	2	3	-	3	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	3	-
CO2	-	-
CO3	3	-
CO4	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24358B	Contact Hrs /week: 14
Course Description: Data Visualization Techniques		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Python		

1. PREAMBLE ABOUT THE COURSE

In today's data-driven world, the ability to communicate complex information clearly and effectively is more important than ever. Data Visualization with Python and Tableau is a comprehensive course designed to equip learners with the essential skills to transform raw data into compelling visual narratives that inform, engage, and inspire decision-making.

This course bridges the gap between analytical programming and interactive visual storytelling. Leveraging the power of Python, students will explore core data analysis and visualization libraries such as Numpy, Pandas and Matplotlib to programmatically create impactful graphics. Complementing this, the course introduces Tableau, one of the leading platforms in business intelligence, enabling students to design dynamic dashboards and perform deep visual analytics without writing code.

The course provides the foundational tools and practical techniques necessary to visualize data effectively, uncover insights, and present results to diverse audiences with clarity and confidence.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the concepts of Numpy and Pandas for data wrangling
CLO2	Understand the basic and advanced statistics for data science
CLO3	Implement Visualization techniques using Python programming and Tableau

3. COURSE OUTCOMES (COs) & COMPETENCIES


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Bangalore

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Illustrate array operations and indexing techniques in NumPy to demonstrate their role in achieving efficient numerical computations.	PO1, PO2, PO5	Analyze	WK1, WK2, WK3, WK4, WK6	08
CO2	Analyze Pandas data structures and their functionalities to perform effective data selection, alignment and transformation.	PO1, PO2, PO5	Analyze	WK1, WK2, WK3, WK4, WK6	08
CO3	Create data visualizations using matplotlib and Pandas to effectively convey insights through clear and meaningful graphical representations.	PO1, PO2, PO3, PO5, PSO1	Create	WK1, WK2, WK4, WK6, WK7, WK8	04
CO4	Apply Tableau functionalities to connect data sources, perform aggregation and visualize data using charts, maps and filters.	PO1, PO5	Apply	WK1, WK2, WK3, WK4, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours
1	a) Develop a Python program that generates an array and executes the following operations on its elements: • Calculate the square and square root of each element • Raise each element to a specified power • Compute the mean and median values of the elements • Determine the sum, minimum, and maximum values of the elements • Calculate the variance and standard deviation • Sort the elements in either ascending or descending order • Identify any unique elements present in the array.	CO1	04

	b) Develop a Python program to generate an array list and showcase the concepts of slicing and indexing on array.		
2	a) Develop a Python program that generates a 2-D array and executes the following operations on its elements: • Determine the number of elements in each dimension. • Identify the Data type of the matrix • Determine the dimension of the matrix • Compute inverse and transpose of the matrix • Determine eigen and determinant values • Create identity matrix • Create an array filled with ones • Create an array filled with zeros • Demonstrate empty() method • Convert the given array to float type b) Develop a Python program that generates a 3-D array and executes the following operations on its elements: • Extract the inner matrix. • Sort the elements rowwise and columnwise	CO1	04
3	Develop a Python program that reads a csv file, converts to Data Frame and performs the following operations on the Data Frame • Compute the summary statistics of the Data Frame • Reshape the Data Frame • Demonstrate pivot_table() method • Determine the duplicate values based on the Column labels except the last occurrence • Replace the values of the Data Frame with respect to labels • Merge the given Data Frames on the given Column	CO2	04
4	Develop a Python program that reads a csv file, converts to Data Frame and performs the following operations on the Data Frame • Compute the summary statistics of the Data Frame • Insert a Row and a Column into the Data Frame • Delete a row and a Column from the Data Frame	CO2	04

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5	The following information is given that contains yearly sales of Smart phones in two Companies for the past six years. <table><tr><th>Year</th><th>Sales_Company_A</th><th>Sales_Company_B</th></tr><tr><td>2018</td><td>650</td><td>780</td></tr><tr><td>2019</td><td>500</td><td>400</td></tr><tr><td>2020</td><td>400</td><td>550</td></tr><tr><td>2021</td><td>800</td><td>650</td></tr><tr><td>2022</td><td>880</td><td>850</td></tr><tr><td>2023</td><td>900</td><td>1000</td></tr></table> Develop a Python program that utilizes the Matplotlib library to visualize the yearly sales trends of both companies using Line plots. Display the values on the graph and save the chart in jpg format.	Year	Sales_Company_A	Sales_Company_B	2018	650	780	2019	500	400	2020	400	550	2021	800	650	2022	880	850	2023	900	1000	CO3	02
Year	Sales_Company_A	Sales_Company_B																						
2018	650	780																						
2019	500	400																						
2020	400	550																						
2021	800	650																						
2022	880	850																						
2023	900	1000																						
6	A dataset in csv format is given that contains Weekly Sales in a Book Fair. Develop a Python program that utilizes the Matplotlib library to create a Bar Chart to compare the number of Book copies sold in Week1, Week2 and Week5. Save the chart in jpg format.	CO3	02																					
7	The following information is given that contains Tax details in a Budget. <table><tr><th>Income Form</th><th>Amount (in Paise)</th></tr><tr><td>Corporation Tax</td><td>21</td></tr><tr><td>Income Tax</td><td>16</td></tr><tr><td>Customs</td><td>4</td></tr><tr><td>Union Excise Duties</td><td>8</td></tr><tr><td>GST & other Taxes</td><td>19</td></tr><tr><td>Non-Tax Revenue</td><td>9</td></tr><tr><td>Non-Debt Capital Receipts</td><td>3</td></tr><tr><td>Borrowings and other Liabilities</td><td>20</td></tr></table> Develop a Python program that utilizes the Matplotlib library to create a Donut Chart to visualize the distribution of Income tax across different categories.	Income Form	Amount (in Paise)	Corporation Tax	21	Income Tax	16	Customs	4	Union Excise Duties	8	GST & other Taxes	19	Non-Tax Revenue	9	Non-Debt Capital Receipts	3	Borrowings and other Liabilities	20	CO3	02			
Income Form	Amount (in Paise)																							
Corporation Tax	21																							
Income Tax	16																							
Customs	4																							
Union Excise Duties	8																							
GST & other Taxes	19																							
Non-Tax Revenue	9																							
Non-Debt Capital Receipts	3																							
Borrowings and other Liabilities	20																							
8	A dataset in csv format is given that contains information about Students' performance in five subjects: English, Math, Science, Social_Science and Computer_Science. Develop a Python program that utilizes the Matplotlib library to create a Scatter Plot to visualize the relationship between the students' scores in any three subjects.	CO3	02																					

9	As a data analyst at a retail company, you are interested in comparing the Sales and Profit performance across different Regions and Subcategories in the Sample-Superstore dataset. Use Tableau Visualization tool to perform the following operations on the given data set. • Create a Column chart to find the sum of Sales for each Region and Category. Sort the details in ascending order of Sales. • Create a Horizontal Bar chart to find the Profit of each Sub-Category and sort them in descending order of Profit. • Create a Tree map to find the Sub-Category that has the highest Sales. • Create a Scatter plot to find the Customers with the highest Profit and Sales.	CO4	02
10	As a data analyst at a retail company, you are tasked to analyze the Sales, Profit and Quantity distribution across different regions for each subcategory and segment in the Sample-Superstore dataset. Use Tableau Visualization tool to perform the following operations on the given dataset • Create a Pie chart to visually represent the proportion of Sales contributed by each Region and sort the details in descending order of Sales. • Create a Bubble chart to find the Sub-Category with the highest and the lowest Quantity. • Create a Heat map to represent the Profit in each Segment for each Sub-Category and sort the details in descending order of Profit. • Create a Box plot to identify the Technology that has the highest Profit.	CO4	02
11	You are provided with Coffee dataset which contains details about Coffee Sales and Profit. Use Tableau Visualization tool to perform the following operations on the given dataset • Display the top 5 States (each in different color) having the highest Sales • Display the Espresso Products in descending order of Sales • In California, display the Product with the highest and lowest Profit • Create a Heat map for Product Type, State, and Profit. Identify which State has the lowest Profit for Espresso	CO4	02

12	You are provided with Coffee dataset which contains details about Coffee Sales and Profit. Use Tableau Visualization tool to perform the following operations on the given dataset • Display the States having the Sales between 50,000\$ and 80,000\$ • Determine the Average Profit for all the Products starting with "C" • In 2013, determine the State with the highest Profit in the West market • Display the bottom 5 States using a Map having the lowest Profit	CO4	02
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Python for Data Analysis	Wes McKinney	O'Reilly	2 nd	All
2	Python Data Science Handbook: Essential Tools for Working with Data	Jake Vander Plas	O'Reilly	1 st	All
3	Python: Data Analytics and Visualization	Phuong Vo.T.H, Martin Czygan, Ashish Kumar, Kirthi Raman	Packt Publishing Limited	1 st	All
4	Introducing Data Science	Davy Cielen, Arno D. B. Meysman, Mohamed Ali	Manning	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/learn/python-for-data-visualization>
2. <https://www.mygreatlearning.com/academy/learn-for-free/courses/data-visualization-using-python>
3. <https://priyadogra.com/data-visualization-with-python-exam-answers-cognitive-class/>


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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	3	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-
CO3	2	2	3	-	3	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	3	-
CO4	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24358C	Contact Hrs /week: 14
Course Description: Functional Programming with Scala		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of any Programming Language		

1. PREAMBLE ABOUT THE COURSE

Scala is a powerful, modern programming language that combines object-oriented and functional programming paradigms. Designed to be concise, expressive, and scalable, Scala runs on the Java Virtual Machine (JVM) and interoperates seamlessly with Java, making it a versatile tool for a wide range of applications—from backend systems to data processing and distributed computing.

This course introduces students to the core concepts of Scala programming, including variables, control structures, functions, collections, classes, and pattern matching. It also explores more advanced features such as higher-order functions, immutability, and concurrency using Scala's functional capabilities. By blending theoretical concepts with practical programming tasks, the course prepares students to write robust, efficient, and maintainable code using Scala.

Through hands-on exercises and real-world examples, students will gain the skills necessary to develop scalable applications and contribute effectively to modern software development environments where Scala is used, such as in big data frameworks like Apache Spark.

2. COURSE LEVEL OBJECTIVES

CLO1	Model data using algebraic data types, represented in Scala as families of sealed traits and case classes
CLO2	Use structural recursion and pattern matching to traverse and transform data
CLO3	Learn programming with the common data structures of Scala
CLO4	Learn object-oriented programming in Scala

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Create applications by integrating Scala syntax and object-oriented principles	PO1, PO2, PO3, PO5, PSO1	Create	WK1, WK2, WK6	06
CO2	Apply advanced concepts such as loops, expressions, inheritance, and pattern matching in program development.	PO1, PO5	Apply	WK1, WK2, WK6	07
CO3	Apply Scala programming concepts to write clean, functional code and test it.	PO1, PO5	Apply	WK1, WK2, WK6	07
CO4	Create applications by implementing functional programming concepts in Scala.	PO1, PO2, PO3, PO5, PSO1	Create	WK1, WK2, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours
1	Develop a Scala application that performs addition, subtraction, multiplication, and division using object-oriented principles (classes, objects, and methods).	CO1	03
2	Create a Scala class Student with attributes (name, roll number, marks) and methods to calculate grade and display details. Implement it in a main program.	CO1	03
3	Write a Scala program using loops to display various number patterns (e.g., pyramid, inverted pyramid).	CO2	02
4	Implement a class hierarchy (Shape, Circle, Rectangle, Triangle) using inheritance, and override methods to compute areas.	CO2	03
5	Write a Scala program that accepts a number (1-7) and uses pattern matching to print the corresponding day of the week.	CO2	02

6	reate a Scala program that uses higher-order functions (map, filter, reduce) to process a list of integers and display results.	CO3	03
7	Write a function to check whether a string is a palindrome, and create test cases using ScalaTest or a similar framework.	CO3	04
8	Write a program that uses anonymous functions to perform arithmetic operations on a list of numbers.	CO4	02
9	Create a Scala application to manage an immutable list of products, applying transformations without altering the original list.	CO4	03
10	Implement both factorial and Fibonacci series generation using recursion in Scala.	CO4	03

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Programming in Scala	Martin Odersky, Lex Spoon, Bill Venners, and Frank Sommers	Artima Press	5 th	All
2	Functional Programming in Scala	Michael Pilquist, Paul Chiusano, and Rúnar Bjarnason	Manning Publications	2 nd	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://docs.scala-lang.org/online-courses.html>
2. <https://www.datacamp.com/courses/introduction-to-scala>
3. <https://www.udemy.com/topic/scala/?srsltid=AfmBOoogKAh7X2QOWEM4i7wVMOxGNmspbkfpPGpSyUv4Xijy djefjPh>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	-	3	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-
CO3	3	-	-	-	3	-	-	-	-	-	-
CO4	3	2	3	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	3	-
CO2	-	-
CO3	-	-
CO4	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: III	Course Code: BCS24358D	Contact Hrs /week: 02
Course Description: Project Management with Git		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: • Basic understanding of software development lifecycle (SDLC) • Familiarity with command-line interface (CLI) • Rudimentary knowledge of any programming language (for context)		

1. PREAMBLE ABOUT THE COURSE

Project Management with Git is a lab-based course that teaches repository setup, staging, and committing changes. By building and merging feature branches and using the stash mechanism, students will practice branching strategies. The program emphasizes remote collaboration, cloning repositories, retrieving and rebasing updates, and merging branches with bespoke merge messages to retain project history. Students will try Git tagging and release management by making lightweight tags for major anniversaries. Advanced Git techniques like cherry-picking commits from one branch to another give students fine-grained code integration control. The course concludes with historical analysis and rewriting techniques to check commits, filter by author and date, review recent changes, and roll back undesirable commits to maintain codebase integrity.

2. COURSE LEVEL OBJECTIVES

CLO1	Be familiar with basic command of Git
CLO2	Create and manage branches
CLO3	Understand how to collaborate and work with Remote Repositories
CLO4	Be familiar with various controlling commands

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Use basic Git commands to create, initialize, and manage repositories for project development.	PO1, PO5, PO11, PSO1, PSO2	Apply	WK1, WK2, WK3, WK4, WK5, WK8	02
CO2	Demonstrate branch creation, switching, merging, and deletion to manage parallel project workflows.	PO1, PO2, PO5, PO9, PO10, PO11, PSO1, PSO2	Apply	WK1, WK2, WK3, WK4, WK5, WK8	04
CO3	Implement collaboration workflows by cloning, pushing, pulling, and resolving conflicts in remote repositories.	PO1, PO2, PO4, PO5, PO9, PO10, PO11, PSO1, PSO2	Apply	WK1, WK2, WK3, WK4, WK5, WK8	06
CO4	Apply Git tags and release management commands to mark versions and manage project milestones.	PO1, PO5, PO9, PO10, PO11, PSO1, PSO2	Apply	WK1, WK2, WK3, WK4, WK5, WK8	04
CO5	Modify and reorganize commit history using Git operations such as amend, rebase, and cherry-pick to refine project versions.	PO1, PO2, PO4, PO5, PO9, PO10, PO11, PSO1, PSO2	Apply	WK1, WK2, WK3, WK4, WK5, WK8	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9


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4. SYLLABUS

Sl. No.	Program Description	Mapped COs	No. of Hours
1	Setting Up and Basic Commands Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message.	CO1	04
2	Creating and Managing Branches a) Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master." b) Write the commands to stash your changes, switch branches, and then apply the stashed changes.	CO2	06
3	Collaboration and Remote Repositories a) Clone a remote Git repository to your local machine. b) Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch. c) Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.	CO3	06
4	Git Tags and Releases a) Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository. b) Write the command to cherry-pick a range of commits from "source-branch" to the current branch.	CO4	06
5	Analysing and Changing Git History a) Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message? b) Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31." c) Write the command to display the last five commits in the repository's history. d) Write the command to undo the changes introduced by the commit with the ID "abc123".	CO5	06



5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Version Control with Git	Prem Kumar Ponuthorai, Jon Loeliger	O'Reilly Media, Inc.	3 rd	All
2	Pro Git book	Scott Chacon and Ben Straub	Apress	-	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944433473699842782_shared/overview
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01330134712177459211926_shared/overview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	2	–	–	–	3	–	–	–	–	–	2
CO2	2	2	–	–	3	–	–	–	2	2	2
CO3	2	3	–	2	3	–	–	–	3	3	3
CO4	2	–	–	–	3	–	–	–	2	2	2
CO5	2	3	–	2	3	–	–	–	2	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	2	1
CO2	2	2
CO3	3	2
CO4	2	2
CO5	3	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High



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Department: Science and Humanities		
Semester: III	Course Code: BNSK24359	Contact Hrs /week: 02
Course Description: National Service Scheme (NSS)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

3. SYLLABUS

Module No.	Module Description
I	National Service Scheme (NSS) – Contents 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swach Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	





GLOBAL ACADEMY OF TECHNOLOGY

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Department: Science and Humanities		
Semester: III to VI	Course Code: BPEK24359	Contact Hrs /week: 02
Course Description: Physical Education (Sports & Athletics) – I		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Lifestyle B. Health & Wellness C. Pre-Fitness test.	04
II	A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash	04
III	1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	16

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Department: Science and Humanities		
Semester: III to VI	Course Code: BYOK24359	Contact Hrs /week: 02
Course Description: Yoga		No. of Credits: L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100	SEE: -	Exam Hours: -

1. SYLLABUS

Course Title	Content
introduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its meaning, definitions. Different schools of yoga, importance of prayer
Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health.
Rules and regulations	Rules to be followed during yogic practices by practitioner.
Misconceptions of yoga	Yoga its misconceptions
Suryanamaskara	Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.
Different types of Asanas Sitting 1. Padmasana 2. Vajrasana Standing 1. Vrikshana 2. Trikonasana Prone line 1. Bhujangasana 2. Shalabhasana Supine line 1. utthitadvipadasana 2. Ardhalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits.



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Department: Science and Humanities		
Semester: III to VI	Course Code: BMUK359/459/559/658	Contact Hrs /week: 02
Course Description: Music		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discuss the Indian system of music and relate it to other genres (Cognitive Domain)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	03
II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	03

III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	03
IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	3
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	4

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramaniam	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007

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Department: Mathematics		
Semester: IV	Course Code: BMATS24401	Contact Hrs /week: 3
Course Title: Probability and Graph Theory (Common for CSE/ISE/AI&DS/AI & ML/CS-AI & ML)		No. of Credits: 3 L : T : P : S = 3:0:0:0
Course Category: Basic Science Course (BSC)		Total no. of Hours = 40
CIE: 50	SEE: 50	Exam Hours: 03
Course Pre-requisites: • A fundamental understanding of calculus and linear algebra. • Basic knowledge of set theory and matrix operations. • Introductory familiarity with probability concepts and high school-level statistics.		

1. PREAMBLE ABOUT THE COURSE

This course is designed to equip students with essential tools from statistics, probability theory, stochastic processes, and graph theory that form the backbone of data analysis, decision-making, and computational modelling in engineering and scientific domains. The course begins with foundational techniques in data fitting and correlation, progresses through theoretical and applied probability models, and extends to stochastic behaviour analysis and hypothesis testing. The final module introduces students to key concepts in graph theory, enabling them to model complex structures like networks, circuits, and hierarchical data. By integrating classical mathematical techniques with modern applications, this course aims to prepare students to apply these tools in engineering contexts, research problems, and real-world systems modelling.

2. COURSE LEVEL OBJECTIVES

By the end of this course, students will be able to:

1. Apply statistical techniques such as least squares fitting, correlation, and regression to analyze and interpret data.
2. Evaluate probability models involving discrete and continuous random variables for a variety of engineering and scientific applications.
3. Analyze joint and conditional distributions, and understand the behaviour of stochastic processes and Markov chains.
4. Conduct statistical hypothesis testing using sampling theory and various test statistics (t, chi-square, F) to make informed decisions.
5. Construct and examine graphs and trees, including Euler and Hamiltonian paths, and use these tools in problems involving sorting, coding, and network structures.

3. COURSE OUTCOMES (COs) & COMPETENCIES

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Analyze and interpret data using statistical techniques such as curve fitting, correlation, regression, and error estimation to support decision-making in computing and data science.	PO1, PO2, PO5	L4	WK1, WK2, WK3, WK6	08
CO2	Apply discrete and continuous probability distributions to model uncertainty in computer systems and support probabilistic algorithm design.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08
CO3	Evaluate joint, marginal, and conditional distributions, and model dynamic systems using stochastic processes and Markov chains in algorithmic contexts.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08
CO4	Perform hypothesis testing using sampling distributions and statistical tests (t , χ^2 , F) to draw conclusions from sample data in experimental and research applications.	PO1, PO2, PO5	L4	WK1, WK2, WK3, WK6	08
CO5	Apply graph theory concepts including Euler and Hamiltonian paths, planar graphs, and tree structures to design and analyze efficient algorithms and data structures.	PO1, PO2, PO5	L3	WK1, WK2, WK3, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9



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4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Statistics: Introduction, Principles of least squares, fitting of a straight line, second degree parabola, . Karl Pearson's coefficient of correlation, Regression analysis standard error of estimate, rank correlation	CO1	08
II	Random variable, Discrete and continuous random variables, Probability distributions: Binomial, Poisson, exponential, uniform and Normal distributions.	CO2	08
III	Joint distributions, Marginal and conditional distributions, Covariance, Correlation. Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability.	CO3	08
IV	Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, student's t-distribution, chi-square distribution as a test of goodness of fit, F- test.	CO4	08
V	Graphs, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits. Planar Graphs, Hamiltonian paths and Cycles. Trees, Rooted Trees, Trees and Sorting, Weighted Trees and Prefix Codes.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44 th
2	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw-Hill	
3	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10 th
4	A Textbook of Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publications	6 th
5	Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks	T Veerarajan	Tata Mc-Graw Hill Co	4 th



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6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- <https://nptel.ac.in/courses>
- <https://swayam.gov.in/nptelonlinecourses.nptel.ac.in/>
- <https://academicearth.org/online-college-courses/>
- <https://elearning.vtu.ac.in/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	1	-	-	1	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-
CO3	3	1	-	-	1	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2	PSO3
COs ↓			
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24402	Contact Hrs /week: 03
Course Description: Object Oriented Programming with Java		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of C, C++, Python		

1. PREAMBLE ABOUT THE COURSE

This course introduces the principles of Object-Oriented Programming (OOP) using Java, focusing on concepts such as classes, objects, inheritance, polymorphism, and encapsulation to develop robust, modular, and reusable software applications.

2. COURSE LEVEL OBJECTIVES

CLO1	Learn fundamental features of Java Programming.
CLO2	Setup Java JDK environment to create, debug and run Java Programs.
CLO3	Learn Object Oriented concepts using Java programs.
CLO4	Apply the concepts of multiprogramming, exception handling, Regular Expressions to develop robust Java programs.
CLO5	Apply String handling methods to write Java programs.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Develop Java programs using fundamental constructs	PO1, PO3, PO5, PO11	Create	WK3, WK4, WK5	06
CO2	Illustrate the concepts of Object-Oriented Programming	PO1, PO3, PO5, PO11	Apply	WK3, WK4, WK5	06

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CO3	Write reusable Java programs using Interfaces and Packages.	PO1, PO2, PO3, PO5, PO11, PSO2	Create	WK3, WK4, WK5	08
CO4	Implement Exception handling mechanism and thread synchronization.	PO1, PO2, PO3, PO5, PO11, PSO2	Apply	WK3, WK4, WK5	08
CO5	Demonstrate pattern matching concepts using Regular Expressions.	PO1, PO2, PO3, PO5, PO11, PSO2	Apply	WK3, WK4, WK5	08
CO6	Write Java programs using String handling functions.	PO1, PO2, PO3, PO5, PO11, PSO2	Create	WK3, WK4, WK5	06

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	The History and Evolution of Java: Java's magic: the Bytecode; The Java Buzzwords. An Overview of Java: Object-Oriented Programming; A First Simple program, A second short program, Lexical Issues. Data types, variables and Arrays: The primitive types, A closer look at Literals, Variables, Type conversion and casting, Automatic type promotion in Expressions, Arrays. Operators: Arithmetic operators, The Bitwise operators, Relational operators, Boolean Logical operators, Assignment operator, The ? operator, Operator precedence. Control Statements: Java's selection statements, iteration statements, Jump statements.	CO1	06
II	Introducing Classes: Classes fundamentals; Declaring objects; Introducing methods, Constructors, the This keyword, garbage collection. Inheritance: Inheritance basics, using super, creating a Multilevel hierarchy, method overriding, Dynamic Method dispatch, Using Abstract classes.	CO2	06
III	Packages and Interfaces: Packages, Member Access, Importing Packages, Interfaces. Exception handling: Exception handling Fundamentals, Exception Types, Uncaught Exceptions, using try and catch, multiple catch clause, nested try statements, throw, throws, finally, Java builtin exceptions.	CO3	12

IV	Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, creating multiple threads, using <code>isAlive()</code> and <code>join()</code> , Thread priorities, Synchronization. Regular Expressions: Regular Expression processing, Pattern, Matcher, Regular Expression Syntax, Demonstrating Pattern matching, Two-pattern matching options, Exploring Regular Expressions.	CO4, CO5	12
V	String handling: The String Constructors, String Length, Special String Operations, Character Extraction, String Comparison, Searching Strings, Modifying a String, Data Conversion Using <code>valueOf()</code> , Changing the case of characters within a String, Joining Strings, Additional String Methods, <code>StringBuffer</code> , <code>StringBuilder</code> .	CO6	06

List of Programs

Sl. No.	Program Description																		
1	Write a Java program to simulate a simple calculator using switch statement. The program must continue executing until the user presses the key 'E'.																		
2	Write a Java program to create a class called Student which stores USN, name and marks of a student. Calculate the Grade according to the following criteria. Input N number of student details, find grade and print all the members. <table border="1"> <thead> <tr> <th>Marks</th><th>Grade</th></tr> </thead> <tbody> <tr> <td>90 to 100</td><td>O</td></tr> <tr> <td>80 to 89</td><td>A+</td></tr> <tr> <td>70 to 79</td><td>A</td></tr> <tr> <td>60 to 69</td><td>B+</td></tr> <tr> <td>55 to 59</td><td>B</td></tr> <tr> <td>50 to 54</td><td>C</td></tr> <tr> <td>40 to 49</td><td>P</td></tr> <tr> <td>0 to 39</td><td>F</td></tr> </tbody> </table>	Marks	Grade	90 to 100	O	80 to 89	A+	70 to 79	A	60 to 69	B+	55 to 59	B	50 to 54	C	40 to 49	P	0 to 39	F
Marks	Grade																		
90 to 100	O																		
80 to 89	A+																		
70 to 79	A																		
60 to 69	B+																		
55 to 59	B																		
50 to 54	C																		
40 to 49	P																		
0 to 39	F																		
3	Write a Java program to create a super class called Staff with the members - staffID, name, phone and salary of the staff members. Extend this class by creating three sub classes namely Teaching (domain, publications), Technical (skills) and Contract (contract_period). Read and display the details of all the sub classes.																		
4	Write a Java program to create a super class called Box with the members - width, height and depth and find the volume of the Box. Extend Box by creating a sub class called BoxWeight to find weight of the Box. Extend BoxWeight by creating a sub																		

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	class called Shipment to find the cost of the shipment. Create two instances of class Shipment to read and display the data.
5	Write a Java program that uses the concept of Interface to find the area of Rectangle and Triangle.
6	Write a Java program that implements a multi-threaded application that has three threads. The first thread generates a random integer every 1 second. The second thread computes the square of the number and prints it. The third thread computes cube of the number and prints it.
7	Write a Java program to input N no. of strings, count the number of vowels and digits in each string using Regular Expressions.
8	Write a Java program to validate USN and email ID of N students using Regular Expressions.
9	Write a Java program to replace all instances of a substring with another within a string.
10	Write a Java Program to input a string and implement Monoalphabetic Cipher.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Java the Complete Reference	Herbert Schildt	McGraw-Hill Education	11 th	All modules
2	Programming with Java	E Balaguruswamy	McGraw-Hill Education	6 th	All modules
3	Java Programming	Surbhi Kakar	Dreamtech Press	2 nd	All modules
4	Core Java: An Integrated Approach	R. Nageswara Rao	Dreamtech Press	1 st	All modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <http://java.sun.com/docs/books/tutorial/>
2. <http://www.onlinecomputerbooks.com/free-java-books.php>
3. https://onlinecourses.nptel.ac.in/noc22_cs47/preview
4. <https://www.udemy.com/course/java-programming-basics/>



7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	1	-	3	-	-	-	-	-	2
CO2	3	-	1	-	3	-	-	-	-	-	2
CO3	3	2	3	-	3	-	-	-	-	-	2
CO4	3	2	3	-	3	-	-	-	-	-	2
CO5	3	2	3	-	3	-	-	-	-	-	2
CO6	3	2	3	-	3	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	2
CO4	-	2
CO5	-	2
CO6	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering			
Semester: IV	Course Code: BCS24403		Contact Hrs /week: 03
Course Description: Software Engineering		No. of Credits: 03 L : T : P : S = 3:0:0:0	
Course Category: PCC		Total no. of Hours = 42	
CIE: 50 Marks		SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Problem-Solving and Logical Thinking			

1. PREAMBLE ABOUT THE COURSE

In the modern era of digital transformation, software engineering plays a pivotal role in shaping the technological foundation of virtually every industry. From the applications on our smartphones to the systems that power critical infrastructure, software has become an integral part of everyday life. As the complexity and scale of software systems continue to grow, the need for structured, reliable, and efficient software development practices has never been more essential.

Software engineering is the disciplined application of engineering principles to the design, development, testing, and maintenance of software systems. It emphasizes quality, scalability, usability, and maintainability, ensuring that software solutions meet user needs and business goals effectively. By blending computer science with engineering methodologies, software engineering provides the tools and frameworks necessary to manage large-scale projects, reduce risk, and improve development productivity.

This preamble sets the stage for an in-depth exploration of software engineering principles, methodologies, tools, and best practices that collectively enable the creation of high-quality software systems in an increasingly digital world.

2. COURSE LEVEL OBJECTIVES

CLO1	Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.
CLO2	Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
CLO3	Recognize the importance of Project Management with its methods and methodologies.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the concepts of software, software engineering practices and various process models	PO1, PO2, PO3, PO11	Understand	WK3, WK4, WK6, WK7	08
CO2	Construct UML models for a given scenario	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK3, WK4, WK6, WK7	08
CO3	Apply different software testing techniques to evaluate software quality and functionality.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply	WK3, WK4, WK6, WK7	08
CO4	Illustrate project planning activities and interpret quality management practices in software engineering.	PO1, PO2, PO3, PO5, PO11, PSO1	Analyze	WK3, WK4, WK6, WK7	08
CO5	Illustrate the Agile process models, Scrum methodology and SPRINT in software development process	PO1, PO2, PO3, PO5, PO11	Analyze	WK3, WK4, WK6, WK7	10

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Software and Software Engineering: The nature of Software, The unique nature of WebApps, Software Engineering, The software Process, Software Engineering Practice, Software Myths. Process Models: A generic process model, Process assessment and improvement, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models, Concurrent models, Specialized process models. Unified Process, Personal and Team process models.	CO1	08
II	Understanding Requirements: Requirements Engineering, Establishing the ground work, Eliciting Requirements, Developing use cases, Building the requirements model,	CO2	08

	Negotiating Requirements, Validating Requirements. Requirements Modeling Scenarios, Information and Analysis classes: Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Data modeling Concepts, Class-Based Modeling. Requirement Modeling Strategies : Flow oriented Modeling , Behavioral Modeling.		
III	Software Testing: Development testing, Test - driven development, Release testing, User testing, Dataflow testing and Path Testing. Software Evolution: Evolution processes, Program evolution dynamics, Software maintenance, Legacy system management.	CO3	08
IV	Project planning: Software pricing, Plan-driven development, Project scheduling, Agile planning, Case Study on Project Planning and Management. Quality management: Software quality, Software standards, Reviews and inspections, Software measurement and metrics.	CO4	08
V	Agile Development: What is Agility?, Agility and the cost of change. What is an agile Process?, Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process . Principles that guide practice: Software Engineering Knowledge, Core principles, Principles that guide each framework activity. Scrum Methodology and Implementation of SPRINT: Roles and Responsibilities in Scrum, implementing Scrum process, estimating a Scrum Project, Tracking Scrum Projects, Communication in Scrum Projects; Sprints, how to Plan and Run an effective Scrum - Sprint; Case Study of APM using Scrum for an Indian E-Governance project.	CO5	10

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Software Engineering-A Practitioners approach	Roger S. Pressman	Tata McGraw Hill.	7 th	1, 2, 3, 4
2	Software Engineering	Ian Sommerville	Pearson Education	10 th	1, 2, 3, 4
3	Agile Project Management with Scrum	Developer Best Practices	Microsoft Press Publication 2019.	-	5
4	An Integrated Approach to Software Engineering	Pankaj Jalote	Wiley India	-	1, 2, 3, 4

5	Software Engineering: Principles and Practice	Hans van Vliet	Wiley India	3 rd	1, 2, 3, 4
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6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc20_cs68
2. <https://nptel.ac.in/courses/106105087>
3. https://onlinecourses.nptel.ac.in/noc24_mg01/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	-	-	-	-	-	-	-	2
CO2	3	2	2	-	1	-	-	-	-	-	2
CO3	3	2	2	-	1	-	-	-	-	-	2
CO4	3	2	2	-	1	-	-	-	-	-	2
CO5	3	2	2	-	1	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	-	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24404	Contact Hrs /week: 03
Course Description: Design and Analysis of Algorithms		No. of Credits: 03 L : T : P : S = 42:0:0:0
Course Category: PCC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C Programming, Data Structures		

1. PREAMBLE ABOUT THE COURSE

The Design and Analysis of Algorithms course is a foundational computer science course that equips students with the skills to design, analyze, and implement efficient algorithms to solve computational problems.

It explores various algorithmic design paradigms, techniques for analyzing algorithm complexity, and fundamental data structures used in algorithms.

The course emphasizes both theoretical understanding and practical application, aiming to develop students' ability to design and analyze efficient algorithms for real-world problems.

2. COURSE LEVEL OBJECTIVES

CLO1	Learn mathematical background for analysis of algorithm
CLO2	Analyze the asymptotic performance of algorithms.
CLO3	Understand the concept of designing an algorithm.
CLO4	Synthesize efficient algorithms in common engineering design situations.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Choose the basic techniques for algorithms' analysis using time and space complexity notations.	PO1, PO2, PO3, PO11, PSO1	Evaluate	WK2, WK4	08

CO2	Design algorithms using Divide and Conquer, Decrease and Conquer techniques for a given problem statement	PO1, PO2, PO3, PO11, PSO1	Create	WK2, WK4	08
CO3	Use Space and Time Tradeoffs, Transform and Conquer approach to model Engineering problems	PO1, PO2, PO3, PO11, PSO1	Apply	WK2, WK4	08
CO4	Assess the suitability of Dynamic Programming and Greedy approaches for solving specific algorithmic problems.	PO1, PO2, PO3, PO11, PSO1	Evaluate	WK2, WK4	10
CO5	Solve computationally hard problems using Backtracking, Branch and Bound design techniques	PO1, PO2, PO3, PO11, PSO1	Apply	WK2, WK4	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Notion of algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. Brute Force: Selection Sort and Bubble Sort.	PO1, PO2, PO3, PO11	08
II	Divide and Conquer: Merge sort, Quicksort, Multiplication of long integers, Strassen's Matrix multiplication, Max-Min Problem Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Applications of DFS and BFS.	PO1, PO2, PO3, PO11	08
III	Transform and Conquer: Presorting, Heapsort, Problem reduction. Space and Time Tradeoffs: Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.	PO1, PO2, PO3, PO11	08
IV	Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, The Knapsack Problem and Memory Functions.	PO1, PO2, PO3, PO11	10

	Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes.		
V	Backtracking: N-Queen's Problem, Sum of Subset Problem. Branch-and-Bound: Travelling Sales Person problem, 0/1 Knapsack problem, Assignment Problems. NP and NP-Complete Problems: Basic concepts, nondeterministic algorithms, P, NP, NP-Complete, and NP-Hard classes	PO1, PO2, PO3, PO11	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson	3 rd	All
2	Introduction to Algorithms,	Cormen T.H., Leiserson C.E., Rivest R.L., Stein G	PHI	3 rd	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://nptel.ac.in/courses/106101060/>
2. <http://www.facweb.iitkgp.ac.in/~sourav/daa.html>
3. <https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms>
4. <https://www.coursera.org/specializations/algorithms>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	-	-	-	-	-	-	-	2
CO2	3	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	2
CO4	3	3	3	-	-	-	-	-	-	-	2
CO5	3	3	3	-	-	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCSL24405	Contact Hrs /week: 03
Course Description: Algorithms Lab		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: PCCL		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C Programming, Data Structure		

1. PREAMBLE ABOUT THE COURSE

The Design and Analysis of Algorithms course is a foundational computer science course that equips students with the skills to design, analyze, and implement efficient algorithms to solve computational problems.

It explores various algorithmic design paradigms, techniques for analyzing algorithm complexity, and fundamental data structures used in algorithms.

The course emphasizes both theoretical understanding and practical application, aiming to develop students' ability to design and analyze efficient algorithms for real-world problems.

2. COURSE LEVEL OBJECTIVES

CLO1	To design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
CLO2	To apply diverse design strategies for effective problem-solving.
CLO3	To Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Interpret the brute-force, divide-and-conquer paradigms	PO1, PO2, PO3, PO5, PO8, PO9, PO11, PSO1	Apply	WK2, WK4	08
CO2	Experiment the design techniques for graph traversal and string matching problems	PO1, PO2, PO3, PO5, PO8, PO9, PO11, PSO1	Apply	WK2, WK4	08
CO3	Demonstrate the greedy technique, dynamic programming for the given problems	PO1, PO2, PO3, PO5, PO8, PO9, PO11, PSO1	Apply	WK2, WK4	10
CO4	Illustrate the Backtracking algorithm to solve given problems.	PO1, PO2, PO3, PO5, PO8, PO9, PO11, PSO1	Apply	WK2, WK4	02

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	Program Description	Mapped COs	No. of Hours
1	a) Implement naïve String matching algorithm using Brute Force Approach b) Implement and analyze iterative and recursive binary search algorithm using divide and conquer method .	CO1	04
2	Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Demonstrate this algorithm using Divide-and-Conquer method .	CO1	04
3	Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Demonstrate this algorithm using Divide-and-Conquer method .	CO1	02



4	a) Incorporate the array data structure and demonstrate whether a given unweighted graph is connected or not using DFS method . b) Implement the graph traversal technique using BFS method to print all the nodes reachable from a given starting node in an unweighted graph.	CO2	02
5	Demonstrate how to obtain the Topological ordering of vertices in a given digraph .	CO2	02
6	Implement Horspool's String matching algorithm.	CO2	02
7	Compute the Transitive Closure for a given directed graph using Warshalls algorithm.	CO3	02
8	For a given weighted graph , construct an All-Pairs Shortest Path using Floyds algorithm.	CO3	02
9	Implement 0/1 Knapsack problem using Dynamic Programming Memory Functions technique.	CO3	02
10	Find Minimum Cost Spanning Tree for a given weighted graph using Prims and Kruskal's algorithm.	CO3	02
11	From a given vertex in a weighted connected graph , determine the Single Source Shortest Paths using Dijkstra's algorithm	CO3	02
12	Demonstrate the working of back tracking approach for solving N-Queen's problem.	CO4	02

Open Ended Programs	
Implement Fractional Knapsack problem using Greedy Method.	
Implementation of Travelling Salesman problem using Dynamic programming	
Mini project proposal should be submitted, and Implementation should be done based on the problem stated in the proposal	

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to the Design and Analysis of Algorithms	Anany Levitin	Pearson	3 rd	05
2	Introduction to Algorithms,	Cormen T.H., Leiserson C.E., Rivest R.L., Stein C	PHI	3 rd	05

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <http://www.facweb.iitkgp.ac.in/~sourav/daa.html>
2. <https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms>
3. <https://nptel.ac.in/courses/106101060/>
4. <https://www.coursera.org/specializations/algorithms>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	3	-	2	-	-	2	2	-	2
CO2	3	3	3	-	2	-	-	2	2	-	2
CO3	3	3	3	-	2	-	-	2	2	-	2
CO4	3	3	3	-	2	-	-	2	2	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24406A	Contact Hrs /week: 03
Course Description: Computational Data Science		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Statistical Tools and Python		

1. PREAMBLE ABOUT THE COURSE

This course provides a comprehensive introduction to Data Science, covering its evolution, key roles, lifecycle, and the technologies that support it. Students will explore different types of data—structured, unstructured, quantitative, and qualitative—as well as the levels of data measurement. Emphasis is placed on data pre-processing, data mining techniques, and core statistical concepts including descriptive and inferential statistics. The course also introduces essential data mining tasks such as classification, regression, clustering, and prediction, along with probability distributions, confidence intervals, and hypothesis testing. Through a blend of theoretical understanding and practical applications, learners will gain the foundational skills needed to analyze data, draw meaningful insights, and make informed, data-driven decisions.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the problems solvable with data science
CLO2	Ability to solve problems from a statistical perspective.
CLO3	To build the skills to create data analytical pipelines
CLO4	To bring the familiarity with the data science ecosystem and the various tools needed to continue developing as a data scientist.

3. COURSE OUTCOMES (COs) & COMPETENCIES

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After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Illustrate Data Science concepts and apply data pre-processing to various datasets	PO1, PO2, PO3, PO5, PSO1	Analyze	WK3, WK4	08
CO2	Analyze data mining tasks, challenges, and applications to extract real-world patterns	PO1, PO2, PO5	Analyze	WK3, WK4	08
CO3	Apply descriptive statistical measures and visualization techniques to summarize and interpret datasets.	PO1, PO5	Apply	WK3, WK4	08
CO4	Analyze probability distributions and estimations to infer from sample data.	PO1, PO2, PO5	Analyze	WK3, WK4	08
CO5	Evaluate hypothesis testing methods for decision-making in real-world case studies	PO1, PO2, PO4, PO5	Evaluate	WK3, WK4	10

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Data Science: Evolution of Data Science, Data Science Roles, Lifecycle of Data Science, Representation of Data Science as a Venn Diagram, Technologies revolving around Data Science. Types of Data: Structured and Unstructured Data, Quantitative and Qualitative Data, Four Levels of data (Nominal, Ordinal, Interval, Ratio Level). Data Pre-processing: Asking interesting question, Obtaining of data, Exploration of data, Modelling of data, Communication and visualization.	CO1	08
II	Data Mining: What is Data Mining? Types of Data Mining, Challenges of implementation in Data Mining, Advantages and Disadvantages, Applications of Data Mining. Overview of Basic Data Mining Tasks: Classification, Regression, Time Series Analysis, Prediction, Clustering, Sequence Discovery	CO2	08
III	Basics of Statistics: Introduction to Statistics, Terminologies in Statistics, Measures of center, variance and relative standing, Normalization of data using the z-score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistics).	CO3	08

	Descriptive Statistics: Data Objects and Attribute, Basic Statistical Description of Data (Measuring the Central Tendency of Data, Measuring the Dispersion of Data, Graphical Displays), Data Visualization Techniques, Measuring Data Similarity and Dissimilarity.		
IV	Inferential Statistics: Overview of Probability Distributions (Bernoulli, Binomial, Poisson, Chi-square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal Distribution, Fisher Estimator, Central Limit Theorem	CO4	08
V	Hypothesis Testing: Testing simple hypotheses, Uniform tests, Two-sided alternatives, t Test, F-Distribution, Bayes Test Procedures, Case studies based on Hypothesis Testing.	CO5	10

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Principles of Data Science	Sinan Ozdemir, Sunil Kakade	Packt Publishing Limited	2 nd	1, 2, 3
2	Probability and Statistics	Morris H Degroot, Mark J Schervish	Pearson	4 th	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/specializations/jhu-data-science>
2. <https://www.coursera.org/professional-certificates/ibm-data-science>
3. <https://www.coursera.org/learn/mathematical-thinking>
4. <https://www.coursera.org/professional-certificates/ibm-datascience>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

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POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	-	1	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-
CO3	3	-	-	-	1	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-
CO5	3	2	-	1	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24406B	Contact Hrs /week: 03
Course Description: Data Analytics with R Programming		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Statistics Tools and Data science		

1. PREAMBLE ABOUT THE COURSE

This R programming course offers a comprehensive introduction to R Programming, focusing on its application in statistical computing, data analysis, and visualization. Designed for beginners and intermediate learners alike, the course covers fundamental programming concepts, essential data structures, control flow, and mathematical operations in R. Students will learn to manipulate data, perform statistical analysis, create graphical visualizations, and build predictive models using regression and machine learning techniques. With practical examples and real-world applications, the course equips learners with the skills needed to analyze complex datasets and derive meaningful insights using R.

2. COURSE LEVEL OBJECTIVES

CLO1	To explore and understand how R and R Studio interactive environment.
CLO2	To understand the different data Structures, data types in R
CLO3	To learn and practice programming techniques using R programming.
CLO4	To import data into R from various data sources and generate visualizations.
CLO5	To draw insights from datasets using data analytics techniques.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the fundamental syntax of R data types, expressions and the usage of the R-Studio IDE	PO1, PO2, PO5, PO8	Analyze	WK2, WK4, WK6	08
CO2	Examine visualization packages and file handlers for data analysis	PO1, PO2, PO4, PO5, PO8, PO10	Evaluate	WK2, WK4, WK6	12
CO3	Apply the list and data frame structure of the R programming language	PO1, PO2, PO4, PO5, PO8, PO10, PSO2	Create	WK2, WK4, WK6	12
CO4	Develop a program in R with programming constructs: conditionals, looping and functions	PO1, PO2, PO4, PO5, PSO2	Create	WK2, WK4, WK6	10

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.	CO1	08
II	R Programming Structures: Control Statements, Loops, - Looping Over Nonvector Sets, If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return-Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree	CO2	08
III	Math and Simulation in R: Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima-Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product-Extended Example: Finding Stationary Distribution	CO3	10

	of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files.		
IV	Graphics: Creating Graphs, The Workhorse of R Base Graphics, the plot () Function, Customizing Graphs, Saving Graphs to Files.	CO3, CO4	08
V	Distributions: Probability Distributions, Normal Distribution-Binomial Distribution-Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests, ANOVA. Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, Poisson Regression-other Generalized Linear Models, Survival Analysis, Nonlinear Models, Splines-Decision-Random Forests.	CO4	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Learning R: A Step by Step Function Guide to Data Analysis	Cotton, R	O'Reilly Media Inc.	1 st	1, 2
2	Introduction to Scientific Programming and Simulation Using R.	Jones, O., Maillardet, R., and Robinson, A.	Chapman & Hall/CRC (The R Series)	2014 Edition	3, 4
3	The Book of R: A First Course in Programming and Statistics	Davies, T.M.	No Starch Press	2016 Edition	5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://onlinecourses.nptel.ac.in/noc24_mg113/preview


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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	2	-	-	1	-	-	1	-	-	-
CO2	3	2	-	1	3	-	-	2	-	1	-
CO3	3	2	-	1	3	-	-	1	-	1	-
CO4	2	2	-	1	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	-	-
CO2	-	-
CO3	-	2
CO4	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24406C	Contact Hrs /week: 03
Course Description: Augmented Reality and Virtual Reality		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: ETC/PLC		Total no. of Hours = 42
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C#, C++, Java, Python		

1. PREAMBLE ABOUT THE COURSE

Augment Reality and Virtual Reality course aims to introduce learners to the fundamentals and applications of Augmented Reality (AR) and Virtual Reality (VR). It will cover the evolution of these technologies, their key concepts, and diverse applications across various industries. The course will also delve into the design processes for creating immersive, interactive experiences and explore the potential of AR/VR to transform interactions with technology.

2. COURSE LEVEL OBJECTIVES

CLO1	Explain the Fundamentals of Virtual Reality
CLO2	Discuss the Various Interfaces - Input and output devices
CLO3	Illustrate the Augmented reality methods and mixed reality.
CLO4	Outline and Utilize various modeling techniques.
CLO5	Select simple AR/VR applications using the frameworks.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain principles of virtual reality and its applications.	PO1, PO2, PO3, PO5, PO11, PSO1	Understand	WK3	08
CO2	Discuss input and output interfaces.	PO1, PO2, PO3, PO5, PO11, PSO1	Understand	WK3	08

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CO3	Discuss Augmented and Mixed Reality technologies.	PO1, PO2, PO3, PO5, PO11, PSO1	Understand	WK5	08
CO4	Explain Geometric modeling, kinematics modeling, physical modelling and behavior modelling.	PO1, PO2, PO3, PO5, PO11, PSO1	Understand	WK5	10
CO5	Describe Virtual Reality and Augmented Reality applications	PO1, PO2, PO3, PO5, PO11, PSO1	Understand	WK5	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: The three I's of virtual reality, commercial VR technology and the five classic components of a VR system. Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.	CO1	08
II	Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. Output Devices: Graphics displays, sound displays & haptic feedback.	CO2	08
III	Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality. wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.	CO3	08
IV	Modeling: Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management	CO4	10
V	Human Factors: Methodology and terminology, user performance studies, VR health and safety issues.	CO5	08

	Applications: Medical applications, military applications, robotics applications, Engineering, Entertainment, Science, Training.		
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Virtual Reality Technology	Gregory C. Burdea & Philippe Coiffet, John	2013 Wiley & Sons, Inc.	2 nd	1 & 2
2	Virtual Reality Technology	Grigore C. Burdea, Philippe Coiffet	2nd Edition, 2006. Wiley Interscience	2 nd	1 & 2
3	Understanding Augmented Reality	Alan B. Craig, Concepts and Applications, Morgan Kaufmann	2013	1 st	3 & 4
4	Spatial Augmented Reality	Merging Real and Virtual Worlds, Oliver Bimber and Ramesh Raskar	2005	-	Module 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/foundation-course-on-virtual-reality-and-augmented-reality/>
2. <https://www.coursera.org/courses?query=augmented%20reality>
3. <https://www.shiksha.com/online-courses/virtual-reality-courses-certification-training-st559-tg1109>
4. <https://www.nielit.gov.in/chandigarh/content/about-arvr>
5. <https://www.geeksforgeeks.org/virtual-reality-vs-augmented-reality-whats-the-difference/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	-	1	-	-	-	-	-	1
CO2	3	3	3	-	1	-	-	-	-	-	1
CO3	3	3	3	-	1	-	-	-	-	-	1
CO4	3	3	3	-	1	-	-	-	-	-	1
CO5	3	3	3	-	1	-	-	-	-	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering			
Semester: IV	Course Code: BCS24406D		Contact Hrs /week: 40
Course Description: Optimization Techniques		No. of Credits: 03 L : T : P : S = 3:0:0:0	
Course Category: AEC/ SEC		Total no. of Hours = 42	
CIE: 50 Marks		SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Mathematics			

1. PREAMBLE ABOUT THE COURSE

Optimization techniques are a fundamental aspect of software and system design, aimed at improving performance, efficiency, and resource utilization. These techniques involve systematically refining code, architecture, and workflows to minimize execution time, reduce memory consumption, enhance responsiveness, and improve scalability. Whether applied in frontend development, backend processing, or full stack architectures, optimization ensures that applications perform reliably under various conditions and user loads. By leveraging best practices such as code minification, lazy loading, caching strategies, algorithmic improvements, and database tuning, developers can deliver faster, leaner, and more robust systems. Optimization is not a one-time task, but an ongoing process that adapts as applications grow in complexity and scale.

2. COURSE LEVEL OBJECTIVES

CLO1	Appreciate the importance of Linear Algebra in Computer Science and Allied Engineering Science.
CLO2	Identify and resolve real life optimization problem the knowledge about various optimization techniques

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Compute optimal solution for Linear Programming problems.	PO1, PO2, PO4, PSO2	Apply	WK3, WK4, WK5	08
CO2	Solve transportation problems using North-West Corner rule, Vogel's Approximation method, and Modified Distribution (MODI) method.	PO1, PO2, PO3, PO4, PSO2	Create	WK3, WK4, WK5	14
CO3	Solve Assignment Problem using Hungarian method.	PO1, PO2, PO3, PO4, PSO2	Create	WK3, WK4, WK5	14
CO4	Illustrate the working principles of advanced optimization techniques	PO1, PO2, PSO2	Apply	WK3, WK4, WK5	06

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Definition, Applications, Phases in Optimization Techniques Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method (Two Variables).	CO1	02
II	LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP	CO1	06
III	Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem.	CO2	14
IV	Assignment Problem: Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems.	CO3	14

	Travelling Salesman Problem (TSP). Difference between assignment and T.S.P.		
V	Advanced Optimization Techniques: Genetic Algorithms, working principle, reproduction, crossover, mutation, advanced GA operators, GA for constrained optimization, PSO, ACO, TLBO, Modified TLBO, Introduction to Graph Theory and orthogonal arrays for optimization applications.	CO4	06

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Operations Research, Theory and Applications	J K Sharma	Laxmi Publications Pvt. Ltd	6 th	All
2	Engineering Optimization	S S Rao	New Age	3 rd	All
3	Introduction to Operations Research	Hillier and Lieberman	McGraw Hill	8 th	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/learn/operations-research-modeling>
2. <https://www.coursera.org/learn/operations-research-algorithms>
3. https://onlinecourses.nptel.ac.in/noc21_me10/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	2	2	-	1	-	-	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	1
CO4	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24457A	Contact Hrs /week: 02
Course Description: MATLAB Essentials		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Programming Skills		

1. PREAMBLE ABOUT THE COURSE

MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate it's use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed.

The objective of this course is to introduce undergraduate students to computational methods using MATLAB. At the end of this course, a student would:

- Learn basics of MATLAB programming
- Get introduced to numerical methods for engineering problems
- Will be able to use MATLAB to solve computational problems

2. COURSE LEVEL OBJECTIVES

CLO1	To learn features of MATLAB as a programming tool.
CLO2	To handle arrays, matrices, and basic data structures
CLO3	To visualize data through basic plots
CLO4	Develop small-scale applications using procedural MATLAB programming

3. COURSE OUTCOMES (COs) & COMPETENCIES

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After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Experiment basic mathematical computations using arrays and matrices .	PO1, PO5	Apply	WK1	04
CO2	Apply control structures and user-defined functions to automate computational problem-solving.	PO1, PO5	Apply	WK3	06
CO3	Develop scripts to visualize data and algorithmic behavior using 2D plots and charts.	PO1, PO2, PO3, PO5, PS02	Create	WK4	06
CO4	Illustrate file input/output operations and string processing for data manipulation.	PO1, PO2, PO3, PO5	Analyze	WK5	06
CO5	Interpret domain-based applications in computation, Image processing and data visualization.	PO1, PO5	Apply	WK5	06

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Sl. No.	Program Description	Mapped COs	No. of Hours
1	Topics: Introduction to MATLAB interface and command window, Variables, Numbers, Operators, Expressions, Input and output and data types, Scripts vs Functions, Input/output and basic formatting. Lab Program: Develop a MATLAB code to perform Simple arithmetic operations and variable assignments in command window and using script files.	CO1	02
2	Topics: Creating row and column vectors, Matrix creation and manipulation, Indexing and slicing, Element-wise vs matrix operations. Lab Program:	CO1	02

	Develop a MATLAB script file to Create and perform various operation on matrices.		
3	Topics: if, else, elseif, switch, for, while loops, Logical operators and conditions. Lab Program: Develop a MATLAB script file to compute various computational algorithms using conditionals and loops.	CO2	02
4	Topics: Built-in Functions, User defined Functions, plot, bar, pie, stem, hist, Multiple plots and subplots, title, labels, grid, legends, Saving and exporting figures. Lab Program: Develop a MATLAB script file to perform Basic 2D plotting in MATLAB.	CO3	02
5	Topics: Reading/writing .txt and .csv files using fopen, fscanf, fprintf, dlmread, csvread. Lab Program: Develop a MATLAB script file to read from and write text and CSV files.	CO4	04
6	Topics: String manipulation using built-in string functions, Character arrays vs string objects, Data formatting and display. Solving Quadratic Equations, Basic Symbolic Calculus and Differential equations Lab Program: Develop a MATLAB script file to Manipulate strings and parse file contents.	CO4	04
7	Topics: Basic Image Processing Lab Program: Develop a MATLAB script file to perform fundamental Image processing operations	CO4	04
8	Topics: Sorting Algorithm Visualization and Simulation Lab Program: Develop a MATLAB script file to sort the data and visualization.	CO5	04
9	Topics: Text Analytics and String Logic Lab Program: Develop a MATLAB script file for the text data analysis.	CO5	04

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Matlab Programming for Engineers	Stephen J Chapman	Thomson Learning	4 th	1, 2, 3
2	A Guide to MATLAB - for Beginners and Experienced Users	Brian R. Hunt, Ronald L. Lipsman, Jonathan M	Rosenberg, Cambridge University Press	2 nd	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://onlinecourses.nptel.ac.in/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	2	-	-	-	3	-	-	-	-	-	-
CO2	2	-	-	-	3	-	-	-	-	-	-
CO3	2	2	1	-	3	-	-	-	-	-	-
CO4	3	2	1	-	3	-	-	-	-	-	-
CO5	2	-	-	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	-	-
CO2	-	-
CO3	-	2
CO4	-	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24457B	Contact Hrs /week: 14
Course Description: User Experience and Interface Design		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of any Programming Language		

1. PREAMBLE ABOUT THE COURSE

In today's digital landscape, the success of software applications and digital products hinges not only on functionality but also on how intuitively and efficiently users can interact with them. User Experience (UX) and Interface Design is a multidisciplinary field focused on enhancing user satisfaction by improving the usability, accessibility, and pleasure provided in the interaction between users and digital products.

This course provides a comprehensive introduction to the principles, processes, and tools of UX and interface design. Students will explore topics such as user research, information architecture, interaction design, wireframing, prototyping, usability testing, and visual design principles. Emphasis is placed on a user-centered design approach that prioritizes the needs, behaviors, and feedback of end-users throughout the development cycle.

By the end of the course, students will be able to design intuitive, aesthetically pleasing, and functional interfaces, supported by industry-standard design practices and tools. The course equips learners with the skills needed to create impactful digital experiences that meet both user expectations and business goals.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand user experience design requirements, with design goals, metrics and targets.
CLO2	Explore different prototyping methods, UX design principles with case examples.
CLO3	Understand the role of design thinking concepts and mental models in UX design

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Illustrate user experience (UX) design requirements in the context of software systems.	PO1, PO5	Apply	WK1, WK2, WK6	04
CO2	Analyze the relationship between design thinking concepts, mental models, and UX design.	PO1, PO2, PO3, PO5	Analyze	WK1, WK2, WK6	06
CO3	Interpret UX design goals, metrics, and targets to evaluate design effectiveness.	PO1, PO2, PO3, PO5	Analyze	WK1, WK2, WK6	06
CO4	Evaluate different prototyping approaches in relation to software engineering practices.	PO1, PO2, PO3, PO5	Evaluate	WK1, WK2, WK6	06
CO5	Create UX design solutions by applying design principles and case-based insights.	PO1, PO2, PO3, PO4, PO5, PSO1	Create	WK1, WK2, WK6	06

WKS are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours
1	Design a responsive layout for a societal application.	CO1	04
2	Explore various UI interaction patterns.	CO1	04
3	Develop an Interface with Proper UI Style Guides.	CO2	02
4	Develop wireflow diagram for application using open-source software.	CO2	02
5	Explore various open-source collaborative interface Platform.	CO3	04
6	Create a Sample Pattern Library for the product (Mood board, Fonts, Colors based on UI principles).	CO3	04
7	Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping.	CO4	04

8	Design with popular tool and build a prototype and perform usability testing and identify improvements.	CO5	04
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The UX Book-Process and Guidelines for Ensuring a Quality User Experience	Rex Hartson and Pardha S. Pyla, Morgan Kaufmann	Elsevier	1 st	All
2	Ultimate Figma for UI/UX Design: Transform Your UI/UX Design, Craft User-Centric Interfaces, and Create Stunning Experiences with Ease	Aditi Sharma	Orange Education Pvt. Ltd	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- https://www.udemy.com/course/figma-ui-ux-design-advanced-tutorial/?srsltid=AfmBOorFbsZI5g4e1sYOVn9E5Mdw_vqOudPFVuNNct10E6I2FSpmUvaT&couponCode=LEARNNOWPLANS
- <https://www.learntube.ai/ui-ux-courses/figma-course>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	3	2	2	-	3	-	-	-	-	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-
CO4	3	2	2	-	3	-	-	-	-	-	-
CO5	2	2	2	1	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
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COs ↓		
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24457C	Contact Hrs /week: 14
Course Description: Full Stack Framework (Frontend)		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Programming Language		

1. PREAMBLE ABOUT THE COURSE

The objective of the Full Stack Framework frontend is to provide a streamlined, responsive, and scalable user interface foundation using HTML, CSS, Bootstrap, JavaScript, and ReactJS. It aims to enable developers to rapidly build dynamic, interactive, and visually appealing web applications through reusable components, modular design, and efficient state management, while ensuring cross-device compatibility and seamless integration with backend services.

2. COURSE LEVEL OBJECTIVES

CLO1	Illustrate the Semantic Structure of HTML and CSS
CLO2	Create forms and tables using HTML and CSS
CLO3	Understand Responsive Web Design with the help of the Bootstrap framework
CLO4	Build dynamic web pages using JavaScript
CLO5	Build applications using React JS

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Design responsive web pages using HTML and CSS syntax and semantics, incorporating tags, tables, and forms	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK2, WK6	06
CO2	Develop responsive designs for web pages using Bootstrap	PO1, PO2, PO3, PO5,	Create	WK1, WK2, WK6	06

		PO11, PSO1			
CO3	Develop interactive features with JavaScript, enhancing user engagement.	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK1, WK2, WK6	08
CO4	Design dynamic user interfaces with ReactJS using its component-based structure and state management capabilities	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK1, WK2, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours
1	Design an organized layout for a Conference webpage using HTML and CSS • Include a header section with the event title, date, and location. • Create a navigation bar with links to sections like "About", "Speakers", "Agenda", "Registration" and "Contact". • In the "About" section, briefly describe the Conference's theme and purpose. • Design a "Speakers" section that lists at least two keynote speakers with their names, titles and photos.	CO1	02
2	Develop an HTML table to display the weekly class timetable, spanning Monday through Friday. • Populate the table with precise class information, including course codes. • Utilize colspan or rowspan to merge cells horizontally or vertically, creating space for breaks or gaps in the schedule. • Implement distinct background colors for cells to differentiate days, timings and break Time.	CO1	02



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3	Design an application form using HTML and CSS • Include fields for Candidate Name, Date of Birth, Gender, Email, Phone, Address, Work • Experience, preferred work location and Textarea for Reference. • Use an option to upload a resume as a document. • Include "Submit" and "Reset" buttons to process the registration.	CO1	02
4	Design a multicolumn layout using HTML and CSS • to position the main content on the left and the sidebar on the right. • to populate the main content area with headings, images, and text. • to populate the sidebar with a list of contents.	CO1	02
5	Design a portfolio webpage using Bootstrap to showcase your skills and projects • Design a header section with your name or a logo. • Use Bootstrap's navbar component to create a simple navigation bar. • Add a brief introduction about yourself or your work. • Utilize Bootstrap's typography classes for consistent styling. • Create a section to list your skills or areas of expertise. • Use Bootstrap's card component to present each skill. • Display a grid of project cards, each with a project name, image, and brief description.	CO2	02
6	Develop a JavaScript program that displays the text 'TEXT-GROWING' with increasing font size every 300 milliseconds, shown in red color. When the font size reaches 50pt, the text should change to 'TEXT-SHRINKING' displayed in blue color, followed by decreasing the font size until it reaches 5pt."	CO3	02
7	Develop a JavaScript program that implements a fading effect for a division element upon clicking. The program should allow users to click on a button, triggering a smooth fade-out transition.	CO3	02
8	Develop a JavaScript program to handle various transformations (translation, rotation, scaling and skewing) using user-triggered events.	CO3	02
9	Develop a JavaScript program to dynamically create multiple divisions and enable drag-and-drop functionality for images onto these divisions using events.	CO3	02



10	Use ReactJS to develop a program that displays a list of books. The program should utilize React components to display the books by extracting the respective keys. Provide clear instructions for setting up the project, creating the necessary components, and rendering the book list.	CO4	02
11	Design a program to build a simple search filter functionality using ReactJS. The program should allow users to enter a search query, and dynamically display a filtered list based on the entered query. Provide clear instructions for setting up the React project, creating the necessary components (such as a search bar component and a list component), and implementing the search functionality.	CO4	04
12	Design a program to create a simple counter application using ReactJS. The counter should start at 0 and allow users to increment, decrement, and reset its value. Provide clear instructions for setting up the React project, creating the necessary components (such as Counter and Button components), and implementing the counter functionality.	CO4	04

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Fundamentals of Web Development	Randy Connolly, Ricardo Hoar	Pearson Education	4 th	All
2	Bootstrap: responsive web development	Jake Spurlock	O'Reilly	1 st	5
3	Programming the World Wide Web	Robert W Sebesta	Pearson Education	4 th	All
4	The Road to React: The React.js 19 with Hooks in JavaScript Book	Robin Wieruch	Independent	1 st	10, 11, 12

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.w3schools.com/js/DEFAULT.asp>
2. <https://www.tutorialspoint.com/reactjs/index.htm>
3. <https://react.dev/learn>
4. <https://www.udemy.com/course/react-the-complete-guide-incl-redux/>
5. <https://getbootstrap.com/docs/5.0/getting-started/introduction/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	2	-	3	-	-	-	-	-	1
CO2	2	2	3	-	3	-	-	-	-	-	1
CO3	3	2	3	-	3	-	-	-	-	-	1
CO4	2	2	3	-	3	-	-	-	-	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: IV	Course Code: BCS24457D	Contact Hrs /week: 14
Course Description: Technical Writing using LATEX		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/ SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: NIL		

1. PREAMBLE ABOUT THE COURSE

LaTeX is a high-quality typesetting system widely used for the production of technical and scientific documentation. It is based on the TeX system created by Donald Knuth and provides a set of macros that simplify the complex formatting tasks of TeX. LaTeX enables authors to focus on content while ensuring consistent and professional formatting, particularly useful for documents containing mathematical formulas, bibliographies, indexes, and structured references. Its markup-based approach makes it ideal for academic and research writing, especially in disciplines such as mathematics, computer science, engineering, and physics.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the basic syntax and semantics of the LaTeX scripting language
CLO2	To understand the presentation of tables and figures in the document
CLO3	To illustrate the LaTeX syntax to represent the theorems and mathematical equations
CLO4	To make use of the libraries (Tikz, algorithm) to design the diagram and algorithms in the document

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply basic LaTeX command to develop simple document	PO1, PO5	Apply	WK3, WK4, WK5	04


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CO2	Develop LaTeX script to present the tables and figures in the document	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK3, WK4, WK5, WK8	06
CO3	Illustrate LaTeX script to present theorems and mathematical equations in the document	PO1, PO5	Apply	WK3, WK4, WK5, WK8	06
CO4	Develop programs to generate the complete report with citations and a bibliography	PO1, PO2, PO3, PO5, PO11, PSO1	Create	WK3, WK4, WK5, WK8	06
CO5	Illustrate the use of Tikz and algorithm libraries to design graphics and algorithms in the document	PO1, PO5	Apply	WK3, WK4, WK5, WK8	06

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Q. No.	Program Description	Mapped COs	No. of Hours																											
1	Develop a LaTeX script to create a simple document that consists of 2 sections [Section1, Section2], and a paragraph with dummy text in each section. And also include header [title of document] and footer [institute name, page number] in the document.	CO1	04																											
2	Develop a LaTeX script to create a document that displays the sample Abstract/Summary.	CO1	04																											
3	Develop a LaTeX script to create a simple title page of the VTU project Report [Use suitable Logos and text formatting].	CO1	02																											
4	Develop a LaTeX script to create the Certificate Page of the Report [Use suitable commands to leave the blank spaces for user entry].	CO1	02																											
5	Develop a LaTeX script to create a document that contains the following table with proper labels. <table><tr><th rowspan="2">Sl. No</th><th rowspan="2">USN</th><th rowspan="2">Student Name</th><th colspan="3">Marks</th></tr><tr><th>Subject1</th><th>Subject2</th><th>Subject3</th></tr><tr><td>1</td><td>4XX22XX001</td><td>Name 1</td><td>89</td><td>60</td><td>90</td></tr><tr><td>2</td><td>4XX22XX002</td><td>Name 2</td><td>78</td><td>45</td><td>98</td></tr><tr><td>3</td><td>4XX22XX003</td><td>Name 3</td><td>67</td><td>55</td><td>59</td></tr></table>	Sl. No	USN	Student Name	Marks			Subject1	Subject2	Subject3	1	4XX22XX001	Name 1	89	60	90	2	4XX22XX002	Name 2	78	45	98	3	4XX22XX003	Name 3	67	55	59	CO2	02
Sl. No	USN				Student Name	Marks																								
		Subject1	Subject2	Subject3																										
1	4XX22XX001	Name 1	89	60	90																									
2	4XX22XX002	Name 2	78	45	98																									
3	4XX22XX003	Name 3	67	55	59																									

6	Develop a LaTeX script to include the side-by-side graphics/pictures/figures in the document by using the subgraph concept.	CO2	02
7	Develop a LaTeX script to create a document that consists of the following two mathematical equations $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad \varphi_\sigma^\lambda A_t = \sum_{\pi \in C_t} \text{sgn}(\pi) \varphi_\sigma^\lambda \varphi_\pi^\lambda$ $= \frac{-2 \pm \sqrt{2^2 - 4 \cdot (1) \cdot (-8)}}{2 \cdot 1} \quad = \sum_{\tau \in C_{\sigma t}} \text{sgn}(\sigma^{-1} \tau \sigma) \varphi_\sigma^\lambda \varphi_{\sigma^{-1} \tau \sigma}^\lambda$ $= \frac{-2 \pm \sqrt{4+32}}{2} \quad = A_{\sigma t} \varphi_\sigma^\lambda$		02
8	Develop a LaTeX script to demonstrate the presentation of Numbered theorems, definitions, corollaries, and lemmas in the document.	CO3	02
9	Develop a LaTeX script to create a document that consists of two paragraphs with a minimum of 10 citations in it and display the reference in the section.	CO4	02
10	Develop a LaTeX script to design a simple tree diagram or hierarchical structure in the document with appropriate labels using the Tikz library.	CO5	02
11	Develop a LaTeX script to present an algorithm in the document using algorithm/algorithmic/algorithm2e library.	CO5	02
12	Develop a LaTeX script to create a simple report and article by using suitable commands and formats of user choice.	CO4	02

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	A Short Introduction to Latex: A Book for Beginners	Firuz Karmali Aibara	Createspace Independent Publishing Platform	1 st	All
2	A Beginner's Introduction to Typesetting with LaTeX	Peter Flynn	Comprehensive TeX Archive Network	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://latex-tutorial.com/tutorials/>
2. <https://shorturl.at/XcIPG>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	-	-	-	3	-	-	-	-	-	-
CO2	2	2	3	-	3	-	-	-	-	-	1
CO3	3	-	-	-	3	-	-	-	-	-	-
CO4	2	2	3	-	3	-	-	-	-	-	1
CO5	3	-	-	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	-	-
CO2	2	-
CO3	-	-
CO4	2	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Artificial Intelligence and Data Science		
Semester: 4	Course Code: BBOK24407	Contact Hrs /week: 2
Course Description: Biology for Engineers		No. of Credits: 1 L : T : P : S = 1:0:0:0
Course Category: BSC		Total no. of Hours = 15
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Foundation in computer basics, including operating systems, and basic network concepts		

1. PREAMBLE ABOUT THE COURSE

Biology for Engineers bridges life sciences with engineering principles. It empowers students to apply biological concepts to innovate in technology and healthcare. Understanding biological systems enhances sustainable design and bio-inspired solutions. This course fosters interdisciplinary thinking for real-world problem-solving.

2. COURSE LEVEL OBJECTIVES

CLO1	To familiarize the students with the basic biological concepts and their engineering applications.
CLO2	To enable the students with an understanding of biodesign principles to create novel devices and structures.
CLO3	To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
CLO4	To motivate the students to develop interdisciplinary vision of biological engineering.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Elucidate the basic biological concepts via relevant industrial applications and case studies.	PO1, PO2, PO7, PSO1, PSO2	L3	WK1, WK3, WK3	05

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CO2	Evaluate the principles of design and development, for exploring novel bioengineering projects.	PO1, PO2, PO7, PSO1, PSO2	L3	WK1, WK3, WK3	05
CO3	Understand and apply biological concepts and emerging technologies such as tissue engineering, bioprinting, biosensing, and AI for solving real-world engineering problems.	PO1, PO2, PO7, PSO1, PSO2	L3	WK1, WK3, WK3	05

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Cell Basic Unit of Life Introduction. Structure and functions of a cell. Stem cells and their application. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, proteins, lipids. Importance of special biomolecules: Properties and functions of enzymes, vitamins and hormones.	CO1	05
II	Adaptation of Anatomical Principles for Bioengineering Design Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.	CO2	05
III	Trends In Bioengineering: Muscular and Skeletal Systems as scaffolds, scaffolds and tissue engineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete. Bioremediation. Biomining.	CO3	05


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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Biology for Engineers	Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K.,	Tata McGraw- Hill, New Delhi, 2012		All Modules
2	Human Physiology	Stuart Fox, Krista Rompolski	McGraw- Hill eBook	16th Edition, 2022	All Modules
3	Biology for Engineers	Arthur T. Johnson	CRC Press, Taylor and Francis, 2011		All Modules
4	Biology for Engineers	Sohini Singh and Tanu Allen,	Vayu Education of India, New Delhi, 2014		All Modules
	Biomimetics: Nature-Based Innovation	Yoseph Bar-Cohen	2012, CRC Press	1st edition	All Modules

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

- <https://nptel.ac.in/courses/121106008>
- <https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists>
- <https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009>
- <https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006>
- <https://www.coursera.org/courses?query=biology>
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- <https://www.classcentral.com/subject/biology>
- <https://www.futurelearn.com/courses/biology-basic-concepts>



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Department: Science and Humanities		
Semester: IV	Course Code: BUHK408	Contact Hrs /week: 01
Course Description: Universal Human Values (UHV)		No. of Credits: 01 L : T : P : S = 1:0:0:0
Course Category: UHV		Total no. of Hours = 15
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03

1. COURSE LEVEL OBJECTIVES

CLO1	To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
CLO2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
CLO3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
CLO4	This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO2	They would have better critical ability.
CO3	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	2	1	-	-	-	-	1	-	-	-	-
CO2	2	1	-	-	-	-	1	-	-	-	-
CO3	2	1	-	-	-	-	1	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	1	1
CO2	1	1
CO3	1	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High


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3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Introduction to Value Education Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	03
II	Harmony in the Human Being Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	03
III	Harmony in the Family and Society Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	03
IV	Harmony in the Nature/Existence Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	03
V	Implications of the Holistic Understanding – a Look at Professional Ethics Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	03



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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	The Textbook A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria	Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1	2nd Revised Edition
2	The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G		
3	Jeevan Vidya: Ek Parichaya	A Nagaraj, Jeevan Vidya Prakashan Amar kantik		1999
4	Human Values New	A.N. Tripathi,	Age Intl. Publishers, New Delhi	2004
5	The Story of My Experiments with Truth	Mohandas Karamchand Gandhi		

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Department: Science and Humanities		
Semester: III to VI	Course Code: BNSK24359	Contact Hrs /week: 02
Course Description: National Service Scheme (NSS)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

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3. SYLLABUS

Module No.	Module Description
I	National Service Scheme (NSS) – Contents 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs. (minimum 5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	



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Department: Science and Humanities		
Semester: IV	Course Code: BPEK24459	Contact Hrs /week: 1
Course Description: Physical Education (Sports & Athletics) – II		No. of Credits: L : T : P : S = 0:0:1:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the ethics and moral values in sports and athletics
CO2	Perform in the selected sports or athletics of student's choice.
CO3	Understand the roles and responsibilities of organisation and administration of sports and games.

2. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Ethics in Sports B. Moral Values in Sports and Games	04
II	A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Athletics (Track Events) – Any event as per availability of Ground.	16
III	Role of Organisation and administration	04

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Department: Science and Humanities		
Semester: III to VI	Course Code: BYOK24359	Contact Hrs /week: 02
Course Description: Yoga		No. of Credits: L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100	SEE: -	Exam Hours: -

1. SYLLABUS

Course Title	Content
Patanjali' s Ashtanga Yoga 1. Yama 2. Niyama	Patanjali' s Asht anga Yoga. Yama :Ahimsa, satya, asteya, brahm acarya, aparigraha Niyama : shoucha, santosh, tapa svaadhy ay a, E shv arapran idhan
Suryanamaskara	Suryanamaskar 12 count 4 rounds
Different types of Asanas a. Sitting 1. Sukhasana 2. Paschimottanas ana b. Standing 1. Ardhakati Chakrasana 2. Parshva Chakrasana c. Prone line 1. Dhanurasana d. Supine line 1. Halasana 2. Karna Peedasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits each asana
Kapalabhati	Meaning, importance and benefits of Kapalabhati. 40 strokes/min 3 rounds
Pranayama – 1. Suryanuloma -Viloma 2. Chandranuloma-Viloma 3. Suryabhedana 4. Chandra Bhedana 5. Nadishodh ana	Meaning, Need, importance of Pranayama. Di fferent types. Meaning by name, technique, precautionary measures and benefits of each Pranayama

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Department: Science and Humanities		
Semester: III to VI	Course Code: BMUK359/459/559/658	Contact Hrs /week: 2
Course Description: Music		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discuss the Indian system of music and relate it to other genres (Cognitive Do main)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	03
II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	03


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III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	03
IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	03
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	04

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramaniam	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007



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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24501	Contact Hrs /week: 03
Course Description: Engineering Economics, Management and Entrepreneurship		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: HSMC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: NIL		

1. PREAMBLE ABOUT THE COURSE

Engineering Economics and Management provides students with the fundamentals of economic principles and management practices essential for effective decision-making in engineering and business. The course emphasizes the scope of managerial economics, objectives of firms, and application of economic theories to practical problems. It also covers management functions such as planning, organizing, directing, communication, and leadership. Special focus is given to entrepreneurship, project formulation, and feasibility analysis for business growth. By bridging theory with practice, the course develops analytical, leadership, and project management skills. Ultimately, it prepares students to contribute to organizations, manage resources efficiently, and pursue entrepreneurial opportunities responsibly.

2. COURSE LEVEL OBJECTIVES

CLO1	Provide an understanding of the nature and scope of Managerial Economics and its role in decision-making.
CLO2	Explain the objectives of business firms and alternative theories of firm behavior.
CLO3	Familiarize students with the principles, functions, and levels of management in organizations.
CLO4	Develop knowledge of planning, organizing, leadership, communication, and coordination as key management practices.
CLO5	Introduce the concepts of entrepreneurship and project preparation, highlighting their role in economic development.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the scope of managerial economics and its role in business decisions	PO1, PO2, PO6, PO8, PO10, PO11, PSO1, PSO2	Understand L2	WK1, WK2, WK6	08
CO2	Construct the objectives of business firms and the theories of profit maximization, sales maximization, and growth maximization.	PO1, PO2, PO4, PO6, PO8, PO11, PSO1, PSO2	Understand L2	WK1, WK2, WK3, WK6, WK8	08
CO3	Illustrate the functions of management- planning, organizing, staffing, directing, and controlling in organizational situations	PO1, PO2, PO3, PO4, PO6, PO9, PO10, PO11, PSO1, PSO2	Understand L2	WK3, WK4, WK6, WK9	08
CO4	Apply the concepts of leadership, communication, coordination, and supervision in business organizations.	PO1, PO2, PO3, PO8, PO9, PO10, PO11, PSO1, PSO2	Understand L2	WK6, WK8, WK9	08
CO5	Design the concepts of entrepreneurship and project management to prepare a basic project report and feasibility analysis.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO10, PO11, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK5, WK6, WK7, WK8, WK9	08

WKS are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9



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4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Nature and Scope of Managerial Economics - Introduction, What is Economics?, What is Managerial Economics? , How Economics Contributes to Managerial Decisions, Application of Economics to Business Decision: An Example, The Scope of Managerial Economics, Some Other Disciplines of Managerial Economics , Managerial Economics Bridges the Gap between Theory & Practice. Objectives of Business Firms - Introduction, Profit as Business Objective, Alternative Objectives of Business Firms, Baumol's Hypothesis of Sales Revenue Maximization, Marris's Hypothesis of Maximization of Firm's Growth Rate, Williamson's Hypothesis of Maximization of Managerial Utility Function.	CO1	08
II	Nature and Functions of Management - Importance of Management, Definition of Management, Management Functions or the Process of Management, Levels of Management, Organisational or Business Functions, Roles of a Manager, Managerial Skills Managerial Effectiveness, Management and Administration, Management A Science or an Art?, Management A Profession?, Professional Management vs Family Management, Management of International Business. Planning: Nature of Planning, Importance of Planning, Types of Plans, Steps in Planning, Difference between Strategic Planning and Tactical Planning, Limitations of Planning, Making Planning Effective, Planning Skills, Strategic Planning in Indian Industry.	CO2	08
III	Organisation: What is an "Organisation"? Process of Organising, Principles of Organising, Span of Management, Departmentalization or the Superstructure of an Organisation, Process Departmentalization. Staffing: Importance and need for proper Staffing. Direction and Supervision - Requirements of Effective Direction, Giving Orders, Motivation, Job Satisfaction, Organizational Commitment, Morale, First-level or Front-line Supervision. Leadership - Difference between a Lead and a Manager, Characteristics of Leadership, Functions of an Executive Leader, Traditional Approaches to Leadership, Leadership	CO3	08

	Effectiveness, New Approaches to Top Leadership, Leadership Assessment, Leadership Style in Indian Organisations, Worker Participation in Management in India.		
IV	Communication - Importance of Communication, Purposes of Communication, Formal Communication, Forms of Communication, Informal Communication, The Communication Process, Barriers to Communication, Principles of Effective Communication, Communication Channels and Networks, Checks on in-plant Communication, Communication in Indian Industries. Coordination - Need for Coordination, Managerial Control-Need for Control System, Benefits of Control.	CO4	08
V	Entrepreneurship - Introduction, Concept of Entrepreneurship, Evolution of the concept, Manager Vs Entrepreneur Functions of Entrepreneur, Characteristics of an Entrepreneur, Types of Entrepreneurs. Intrapreneurs-An emerging class, Stages in Entrepreneurial Process, Role of Entrepreneurs in Economic Development, Entrepreneurship in India Barriers to Entrepreneurship. Preparation of project - Introduction, Meaning of Project, Project Identification, Project Selection, Report-Need and Significance, Contents of a Project Report Project Formulation, Guidelines by Planning Commission for Project Report, Errors in Project Report, Project Appraisal, Market Feasibility Study, Technical Feasibility Study, Financial Feasibility Study, Social Feasibility Study.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Managerial Economics	Dwivedi D. N	Vikas Publishing House	8 th	1
2	Principles of Management	P.C Tripathi, P.N Reddy	Tata McGraw Hill,	6 th	2, 3, 4, 5
3	Managerial Economics	Geethika, Ghosh & Choudhury	McGraw Hill Education	3 rd	1, 2, 3, 4, 5
4	Management and Entrepreneurship	Kaniksha Bedi	Oxford University Press	1 st	1, 2, 3, 4, 5



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6. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	2	-	-	-	2	-	2	-	2	2
CO2	3	3	-	2	-	2	-	2	-	-	2
CO3	3	3	2	2	-	2	-	-	2	2	2
CO4	2	2	2	-	-	-	-	3	3	3	2
CO5	3	3	3	2	2	2	-	3	3	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

7. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24502	Contact Hrs /week: 03
Course Description: Computer Networks		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C programming, Logical Design and Computer Organization		

1. PREAMBLE ABOUT THE COURSE

The course Computer Networks introduces the fundamental concepts, principles, architectures, and protocols that enable communication between computing devices. It provides an in-depth understanding of how data is transmitted across networks, from the physical transmission of bits to end-to-end delivery of application messages.

2. COURSE LEVEL OBJECTIVES

CLO1	To provide the basic knowledge of Computer Networks and its Models.
CLO2	To gain knowledge of the functionalities of the OSI/TCP/IP model
CLO3	To upskill the knowledge of implementation of the 7 layers functionality such as flow control, error control and addressing schemes
CLO4	To study the various protocols of all the layers and its applications.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the concepts, architecture, and functionalities of computer networks and layered communication models.	PO1, PO2, PO5, PSO2	Understand L2	WK1, WK2	04
CO2	Apply fundamental data communication techniques to support reliable and efficient	PO1, PO2, PO3, PO5, PSO2	Apply L3	WK3, WK4	13

	network operations for Data link and network functionalities				
CO3	Analyse addressing mechanisms, routing strategies, and network operations to facilitate effective connectivity.	PO1, PO2, PO3, PO5, PSO2	Apply L3	WK5, WK6, WK7	07
CO4	Evaluate transport and application layer communication mechanisms for improved network performance and usability.	PO1, PO2, PO5, PSO2	Apply L3	WK8, WK9, WK10	16

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Networks, Network types. Network Models: TCP / IP protocol suite, Addressing, The OSI Model. Data link layer: Flow control protocols: stop and wait, sliding window (go back n and selective repeat), HDLC frame format.	CO1, CO2	08
II	Multiple access protocols: Random access protocols - Slotted ALOHA, CSMA/CD, CSMA/CA. Error Detection: Error Detection and Correction, Cyclic Codes (Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials), Checksum	CO2	08
III	Network Layer: Network Layer Services, IPV4 Addresses (Address Space, Classful Addressing, Classless Addressing), NAT, DHCP, IPV6 Addressing, IPV6 Protocol, Transition from IPV4 to IPV6. Network Layer Protocols: Unicast Routing (Link State routing, Distance Vector Routing)	CO2, CO3	08
IV	Transport Layer: Introduction, Services Port Numbers User datagram protocol: User Datagram, UDP Services, UDP Applications Transport Layer Protocols, User Datagram Protocol, The TCP Protocol: TCP services, TCP features, Segment Header, TCP Connection Establishment, TCP Connection Release.	CO4	08

V	TCP State Transition, Flow control, Error control, TCP Congestion Control. Application Layer: Introduction, Standard Client Server Protocols – World Wide Web and HTTP, FTP, Domain Name System (DNS)	CO4	08
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List of Programs

Question No.	Program Description	COs Mapped
1	Using Cisco packet tracer, create a topology and simulate sending a simple PDU from source to destination using hub and switch as connecting devices and demonstrate ping.	CO1, CO2
2	Develop a C program to demonstrate Address Resolution Protocol operation.	CO2
3	Develop a C program to compute i) The CRC at the transmitter for the given message and generator polynomial ii) The Syndrome at the receiver to detect the possible error during the transmission	CO2
4	Perform subnetting on IPv4 addresses using Cisco Packet Tracer.	CO3
5	Develop a C program to demonstrate Link state routing algorithm	CO3
6	Develop a C program to demonstrate Distance vector routing algorithm.	CO3
7	Perform File Transfer in Client & Server Using TCP/IP based on Socket programming.	CO4
8	Use Wireshark to capture and analyze HTTP traffic, and identify the key fields present in HTTP GET and POST requests. Interpret how these fields facilitate communication between the client and server.	CO4
9	Develop a DNS client-server application to resolve a given hostname or IP address, and analyze the packet exchange using Wireshark to understand the DNS resolution process.	CO4

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Data Communications and Networking	Behrouz A Forouzan	McGraw Hill	5 th	1-5
2	Data and Computer Communication	William Stallings	Pearson Education	8 th	Reference

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://nptel.ac.in/courses/106105081>
2. https://onlinecourses.nptel.ac.in/noc22_cs53
3. <https://www.hpe.com/us/en/home.html>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	-	-	3	-	-	-	-	-	-
CO2	3	3	1	-	2	-	-	-	-	-	-
CO3	3	3	1	-	2	-	-	-	-	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24503	Contact Hrs /week: 03
Course Description: Database Management Systems		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Any Programming Language, Set Theory concepts		

1. PREAMBLE ABOUT THE COURSE

The course introduces the fundamental concepts of database design, relational models, and structured query language (SQL) and Transaction Processing. It equips students with the skills to model, create, and manage efficient and secure databases essential for Real Time Database Applications.

2. COURSE LEVEL OBJECTIVES

CLO1	Outline a strong foundation in database concepts, technology, and practice.
CLO2	Identify a strong foundation on normalization techniques to design a database
CLO3	Design and build database applications for real world problems
CLO4	Demonstrate the use of concurrency and transactions in database

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the principles of ER modelling to represent simple database applications, with the concepts of functional dependencies, and transaction processing.	PO1, PO2, PO5, PO8, PSO2	Apply L3	WK2, WK3, WK4	08
CO2	Solve relational algebraic operations by breaking down complex queries into their	PO1, PO2, PO8	Apply L3	WK2, WK3, WK4	08

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	fundamental expressions for efficient query formulation.				
CO3	Use the various concurrency control mechanisms by exploring how locking, timestamp ordering handle anomalies in simultaneous database operations.	PO1, PO2, PO3, PO5	Apply L3	WK2, WK3, WK6	06
CO4	Implement SQL/PL-SQL queries using relational model concepts to create optimized solutions for complex database requirements.	PO1, PO2, PO3, PO5, PO8, PO10, PSO2	Apply L3	WK2, WK3, WK4, WK6	10
CO5	Apply relational database normalization concepts to design application schemas and manage the transition from structured relational databases to unstructured databases.	PO1, PO2, PO3, PO5, PO8, PO10, PSO2	Apply L3	WK2, WK3, WK4, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Introduction, Characteristics of Database approach, Advantages of using DBMS approach, Data models, schemas and instances, Three- schema architecture and data independence Entity-Relationship Model: Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Sample ER Diagrams.	CO1	08
II	Relational Model and Relational Algebra: Relational Model Concepts, Mapping Conceptual Design into Logical Design: Relational Database design using ER to Relational Mapping. Case Study on real time examples. Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory Binary Relational Operations: JOIN and DIVISION, Examples Queries in Relational Algebra.	CO2	08

III	SQL: SQL Data Definition and Data Types, specifying constraints in SQL, Schema change statements: Alter, Drop, Basic Retrieval Queries in SQL, Insert, Delete, Update statements in SQL. SQL Advanced Queries: More complex SQL Queries using Joins, Triggers in SQL, Views (Virtual tables) in SQL.	CO4	08
IV	PL/SQL Programming: PL/SQL, syntax, examples, Control Structures; If and Loops in Procedure; create & drop Procedure; Introduction to Cursor, Cursor within for loops Database Design: Informal Design Guidelines for Relation Schemas, Functional dependencies, Normal Forms Based on Primary Keys, First, Second, Third and Boyce Codd Normal Forms. Transition from RDBMS Tables to NOSQL Collections: Why NoSQL, CRUD operations, Indexing & Aggregating in MongoDB.	CO4, CO5	10
V	Transaction Management: Introduction to Transaction Processing, Transaction states, Desirable properties of Transactions, Characterizing Schedules based on Serializability, Precedence Graphs. Two-phase locking techniques for Concurrency control, ARIES Recovery Algorithm, SQL Transactions and Concurrency Control example exercises.	CO3	06

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	7th Edition	1, 2, 3, 4, 5
2	Oracle Database 11g SQL: Master SQL and PL/SQL in the Oracle Database	Jason Price	Oracle Press (McGraw-Hill Education)	1 st Edition	4
3	Database Management Systems	Raghurama Krishnan, Johannes Gehrke	Tata McGraw Hill	3rd Edition	1, 2, 3, 4, 5
4	MongoDB: The Definitive Guide – Powerful and Scalable Data Storage	Kristina Chodorow	O'Reilly Media	2nd Edition	4



6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://www.w3resource.com/sql-exercises/sql-transactions-and-concurrency-control_index.php
2. NPTEL Course on Database Management Systems by Prof. Partha Prathim and Prof. Pramiran Chattopadhyay: https://onlinecourses.nptel.ac.in/noc21_cs04/preview.
3. <https://db-book.com/db6/slide-dir/index.html>
4. <https://www.udemy.com/course/introduction-to-database-management-systems-dbms/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	2	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	1	-	-	-
CO3	2	2	1	-	2	-	-	-	-	-	-
CO4	2	2	1	-	3	-	-	3	-	2	-
CO5	3	2	2	-	3	-	-	3	-	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	1
CO2	-	-
CO3	-	-
CO4	-	1
CO5	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: V	Course Code: BCSL24504	Contact Hrs /week: 02
Course Description: DBMS Lab with Mini Project		No. of Credits: 01 L: T : P : S = 0:0:2:1 (0:0:28:2)
Course Category: PCCL		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Any Programming Language		

1. PREAMBLE ABOUT THE COURSE

This course helps students learn how to design, create, and use databases. Students get hands-on practice with SQL to store, organize, and manage data. The lab also teaches basic concepts like data models, normalization, and programming using SQL/PL-SQL using real-life examples. DBMS lab with mini project targets at practicing and accomplishing this aim by using MySQL/Oracle as well as gain proficiency to design database and its hierarchical structure for given real world application.

2. COURSE LEVEL OBJECTIVES

CLO1	Foundation knowledge in Database concepts, technology and practice to groom students into well informed database application developers.
CLO2	Identify a strong foundation on SQL and normalization techniques to design a database
CLO3	Develop a database application using Front end tools and Back-end database systems.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply database concepts to design relational schemas with primary and foreign keys and use SQL commands to manage and control data in relational databases.	PO1, PO2, PO3, PO5, PO11, PSO2	L3	W2, W3, W4	10

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CO2	Analyse the concepts of normalization to reduce data redundancy and improve database design in structured and unstructured databases.	PO1, PO2, PO3, PO5, PO8, PO11, PSO2	L3	W2, W3, W4, W6	10
CO3	Implement triggers and stored procedures for efficient data handling to develop the application project.	PO1, PO2, PO3, PO5, PO8, PO9, PO11, PSO2	L3	W2, W3, W4, W6	8

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

PART A SQL Programming

Design, develop, and implement the specified queries for the following problems using Oracle, MySQL, MS SQL Server, or any other DBMS under Linux/ Windows environment. Construct Schema and insert at least 5 records for each table. Add appropriate database constraints.

Program No.	Program Description	Mapped COs	No. of Hours
I	Create Schema and insert at least 5 records in each table and add appropriate constraints for the following Library Database. BOOK (Book_id, Title, Publisher_Name, Pub_Year) BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone) BOOK_COPIES (Book_id, Branch_id, No-of_Copies) BOOK_LENDING (Book_id, Br_id, Card_No, Date_Out, Due_Date) LIBRARY_BRANCH (Branch_id, Branch_Name, Address) Write SQL queries to - Get the particulars of borrowers who have borrowed more than 2 books, in the year 2020. - Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation. - Display the total number of books published by each Publisher. - Create a VIEW that displays the books that are currently not borrowed by anyone or the books that are overdue.	1	4
II	A retail store maintains details of its products and suppliers. Product (ProdID, ProdName, UnitPrice, Discount, SupplierID) Supplier (SupplierID, SupplierName, Location)	1	4

	Create the necessary tables by properly specifying primary and foreign keys, insert few tuples to the relations and perform the following operations on the database: - Ensure that the UnitPrice of a product is never less than 100 by using an appropriate CHECK constraint while creating the Product table. - Write an SQL query to create a VIEW that stores the product name, unit price, discount percentage, and the final price after applying the discount for each product. - Write an SQL query to display the names of suppliers who supply at least one product whose UnitPrice is greater than 1000 (use EXISTS operator). - Write an SQL query to display the product names and their supplier names for all products whose UnitPrice is greater than the average UnitPrice of all products. - Write an SQL query to display the top 3 products (ProdName, UnitPrice, Discount) with the highest discount percentage.		
III	The commercial bank wants keep track of the customer's account information. Each customer may have any number of accounts and account can be shared by any number of customers. The system will keep track of the date of last transaction. We store the following details. a) Account: unique account-number, type and balance b) Customer: unique customer-id, name and several addresses composed of street, city and state. Create necessary tables, insert few tuples to all the relations and perform the following operations on the database: - Add 5% interest to the customer who have less than 10000 balance. - Find all the customers who have at least two accounts in the Bank. - Find the customer who has not done any transaction. - Classify customers based on their total balance across all accounts: "Low Balance" if less than ₹3,000 "Medium Balance" if between ₹3,000 and ₹10,000 "High Balance" if more than ₹10,000 (use CASE-WHEN-THEN)	1,2	4

IV	Consider the following Movie Database with the given requirements: • ACTOR is a relation in which each Actor is uniquely identified by an Actor ID. The table stores the attributes Actor Name and Actor Gender. • DIRECTOR is a relation in which each Director is uniquely identified by a Director ID. The table stores the attributes Director Name and Director Phone Number. • MOVIES is a relation in which each Movie is uniquely identified by a Movie ID. The table stores the attributes Movie Title, Movie Year, and Movie Language. Each movie is directed by exactly one Director. • MOVIE_CAST is a relation that maintains information about actors working in movies. It stores the Role played by the actor in that movie. • RATING is a relation that stores reviews given for movies. It includes the number of Review Stars given by the viewers. Create necessary tables, insert few tuples to all the relations and perform the following operations on the database: a. List all actors who acted in a movie before 2000 and in a movie after 2015 (use JOIN operation). b. Update rating of all movies directed by 'Steven Spielberg' to 5. c. Retrieve the names of directors who have directed more than one movie. d. Create a trigger on the RATING table such that whenever a record is deleted, the details of the deleted record are automatically stored in another table called RATING_DELETE_LOG. The log table should store the Movie_ID, Review_Stars, and the timestamp of deletion.	1,2,3	4
V	Consider the schema for College Database: STUDENT(USN, SName, Address, Phone, Gender) SEMSEC(SSID, Sem, Sec) COURSE(Subcode, Title, Sem, Credits) IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA) Write SQL queries to a. List all the student details studying in fourth semester 'C' section. b. Create a view of Test1 marks of student USN '1GA15CS101' in all Courses. c. Using PL/SQL block, calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.	1,2,3	4

	d. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA < 12 then CAT = 'Weak' Give these details only for 8th semester A, B, and C section students.		
VI	Perform the following DB operations using MongoDB (NoSQL Database): a. Create a collection named Customers with the following attributes: Customer_id, Account_Type, Account_Balance b. Insert at least 5 records into the collection. c. Write a query to display the records where the total account balance is greater than 10000 for account type 'Savings' for each Customer_id. d. Determine the Minimum and Maximum account balance for each Customer_id. e. Drop the collection.	2	2

PART B
Mini project (6 Hours)

Use JavaScript/React JS/Java/C#/Python/PHP, or any other similar Front End tool to connect database (such as MySQL, Oracle, MongoDB, or any similar databases). All applications must be demonstrated on desktop/laptop as a standalone or web-based application. (Mobile Apps are not permitted)

- For any Problem selected, Draw the ER Diagram, Apply the mapping rules, normalize the relations.
- Make sure the application has five or more tables, with all the concepts covered in the syllabus.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Fundamentals of Database Systems	Elmasri and Navathe	Pearson Education	7th Edition
2	Oracle Database 10g:PL/SQL Fundamentals	Tulika Srivastava, Sunitha Patel	Oracle Corporation	Edition 2.1
4	MongoDB: The Definitive Guide – Powerful and Scalable Data Storage	Kristina Chodorow	O'Reilly Media	2nd Edition

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. NPTEL Course on Database Management Systems by Prof. Partha Prathim and Prof. Pramiran Chattopadhyay
2. <https://www.udemy.com/course/introduction-to-database-management-systems-dbms/>
3. <https://www.edureka.co/blog/procedures-in-sql/>

7. EVALUATION METHODOLOGY

a) Continuous Internal Evaluation (CIE) = 50 marks

b) Semester End Examination (SEE) = 50 marks

Total = 100 marks

CIE Framework:

Components	Marks	Total
CIE Test	20	50
Lab Week wise Evaluation	20	
Mini Project	10	

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have Part A & Part B, where in Part A, students will have to answer one FULL question.
- Part B will have demonstration of the Mini Project carried out.

8. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2		2	-	-	-	-	-	2
CO2	2	3	3		3	-	-	2	-	-	2
CO3	2	3	3		3	-	-	3	2	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

9. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24505A	Contact Hrs /week: 03
Course Description: Natural Language Processing		No. of Credits: L : T : P : S = 3:0:0:0
Course Category: Professional Elective Course		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Python Programming, Linear Algebra		

1. PREAMBLE ABOUT THE COURSE

Natural Language Processing, the discipline of teaching computers to comprehend human language, is thoroughly introduced in this course. It investigates the basic ideas, models, and algorithms that enable computers to process and evaluate speech and text data. The curriculum strikes a mix between real-world applications powered by cutting-edge machine learning and deep learning techniques and theoretical underpinnings from computational linguistics.

A strong grasp of NLP is more important than ever as AI is incorporated into our daily lives through programs like chatbots, virtual assistants, and search engines. From simple text processing to more complex tasks like sentiment analysis, machine translation, and text summarization, this course will provide you the tools you need to solve real-world language challenges.

After finishing, you will be able to create and develop NLP programs, analyze enormous volumes of unstructured text data, and contribute to the quickly developing field of artificial intelligence.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn the fundamentals of natural language processing.
CLO2	To understand the working of Language based models and apply word embedding algorithms.
CLO3	To understand the role of semantics of sentences and pragmatics and apply them in NER.
CLO4	To perform sentiment analysis and text classification.
CLO5	Facilitate project-based opportunities under machine translation, dialog systems and ethical considerations in NLP.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand NLP foundations, text processing techniques, and practical applications.	PO1, PO2, PO4, PO5, PSO1	L2	WK4, WK5, WK6	08
CO2	Apply diverse language models, embeddings; adapt in practical applications.	PO1, PO2, PO4, PO5, PSO1	L3	WK4, WK5, WK6	08
CO3	Implement tagging, parsing, Named Entity Recognition techniques.	PO1, PO2, PO4, PO5, PSO1	L3	WK4, WK5, WK6	08
CO4	Perform classical NLP, sentiment analysis, text classification, and summarization.	PO1, PO2, PO4, PO5, PSO1	L3	WK4, WK5, WK6	08
CO5	Obtain competence in machine translation, dialog systems, and ethical NLP practices.	PO1, PO2, PO4, PO5, PSO1	L3	WK4, WK5, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to NLP and Text Processing: Definition and scope of NLP, Historical overview and milestones in NLP, Components of NLP, NLP applications, Phases of NLP, Tokenization, Stemming, Lemmatization, Stop word removal, Zipf's law, Punctuation handling, Text normalization, Case conversion	CO1	08
II	Language Modeling: Bag of Words, Bag of N-grams, TF-IDF, Hashing with HashingVectorizer, Split words, Encoding with one_hot, Hash encoding, N-gram models and language probability. Word embeddings: Word2Vec, Training word embeddings, Applications of word embeddings, Word embedding algorithms, CBOW, Skip-Gram, GloVe, reuse an embedding, Gensim Python Library, Plot word vectors using PCA.	CO2	08

III	Syntax, Parsing: Part-of-speech tagging, Dependency parsing and constituency parsing, Parsing algorithms and techniques. Named Entity Recognition: Introduction to NER, NER techniques and tools, Applications of NER in information extraction	CO3	08
IV	Applied NLP: Classical NLP pipeline, Sentiment analysis applications in social media and reviews, Text classification methods, Interpreting Text Classification models, Text summarization	CO4	08
V	Machine Translation and Dialog Systems: Introduction to machine translation, Statistical and neural machine translation, Types of dialog systems, Introduction to chatbots and virtual assistants. NLP Ethics and Bias: Ethical considerations, Fairness, Accountability, Multilingual NLP	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep Learning for Natural Language Processing	Jason Brownlee	Machine Learning Mastery	edition v1.8	1
2	Practical Natural Language Processing	Sowmya Vajjala, Bodhisattwa Majumder, O'Reilly	O'Reilly Media	1 st Edition	1, 2, 3, 4, 5
3	Foundations of Statistical Natural Language Processing	Christopher D. Manning, The MIT Press,	The MIT Press	2 nd Edition	2
4	Natural Language Processing with Python	Steven Bird, Ewan Klein, and Edward Loper, O'Reilly,	O'Reilly Media	1st edition	1
5	Speech and Language Processing	Daniel Jurafsky, James H. Martin,	Pearson / Prentice Hall	3 rd edition	1, 2, 3, 4
6	Natural Language Processing in Action (E-Books / Web References)	Hobson Lane, Cole Howard, and Hannes Max.	Manning Publications	-	1, 2, 3, 4, 5

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6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.udemy.com/course/data-science-natural-language-processing-in-python/>
2. <https://www.coursera.org/specializations/natural-language-processing>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	1	2	-	-	-	-	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-
CO3	3	2	-	1	2	-	-	-	-	-	-
CO4	3	2	-	2	2	-	-	-	-	-	-
CO5	3	2	-	2	2	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	2	-
CO5	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24505B	Contact Hrs /week: 03
Course Description: Microcontrollers and Embedded Systems		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: NIL		

1. PREAMBLE ABOUT THE COURSE

Microcontrollers and Embedded Systems is a foundational subject in electronics and computer engineering that focuses on the design and application of microcontroller-based systems for real-world tasks. A microcontroller is a compact single-chip computer that integrates a processor, memory, and input/output peripherals to perform specific dedicated functions efficiently. Embedded systems combine both hardware and software components to control, monitor, and automate devices ranging from household appliances to industrial machines. Unlike general-purpose computers, embedded systems are optimized for specific applications, often with constraints on power consumption, cost, and real-time performance. This course covers the basics of microcontroller architecture, programming, interfacing techniques, and the role of embedded systems in modern smart devices.

2. COURSE LEVEL OBJECTIVES

CLO1	Provide the student with the basic understanding of microcontroller and embedded systems design.
CLO2	Learn the addressing modes, instructions, and assembler directives and develop the ALP to solve problems.
CLO3	Develop embedded C programs for microcontrollers and run on the simulator, target board and various interfaced hardware devices.
CLO4	Use Microcontroller peripheral programming and embedded onboard and external serial protocols to design required embedded systems.


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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Describe ARM embedded systems and ARM processor fundamentals.	PO1, PO2, PO8	Understand L2	WK2 WK3	08
CO2	Explain ARM instruction set and ARM assembly language programs.	PO1, PO2, PO8	Understand L2	WK2 WK3	10
CO3	Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.	PO1, PO2, PO8, PSO2	Understand L2	WK2 WK3	08
CO4	Understand the characteristics, quality attributes of Embedded Systems, Hardware Software Co-Design	PO1, PO2, PO8, PO11	Understand L2	WK2 WK3	08
CO5	Discuss the need of real time operating system for embedded system applications.	PO1, PO2, PO8, PO11, PSO2	Understand L2	WK2 WK3	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	ARM Embedded Systems: Microprocessors versus Microcontrollers, ARM Embedded Systems: The RISC design philosophy, The ARM Design Philosophy. Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions.	CO1	08
II	Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants, Simple programming exercises.	CO2	08
III	Embedded System Components: Definition of Embedded System, Embedded Systems Vs General Computing Systems,	CO3	08

	Classification of Embedded systems, Major applications and purpose of ES. Core of an Embedded System including all types of processor/controllers, Memory, Sensors, Actuators, 7 segment LED display. Push button switch, Communication Interface (onboard and external types).		
IV	Embedded System Design Concepts: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems Application and Domain specific, Hardware Software Co-Design and Program Modelling, Embedded firmware design and development.	CO4	08
V	RTOS and IDE for Embedded System Design: Operating System basics. Types of operating systems. Task. process and threads (Only POSIX Threads with an example program). Thread preemption. Preemptive Task scheduling techniques. Task Communication, how to choose an RTOS.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	ARM system developer's guide	Andrew N Sloss, Dominic Symes and Chris Wright	Elsevier, Morgan Kaufman publishers	2008	Module 1,2
2	Introduction to Embedded Systems	Shibu K V	Tata McGraw Hill Education Private Limited	2nd Edition	Module 3,4,5
3	Microcontroller (ARM) and Embedded System	Raghunandan G.H	Cengage learning Publication	2019	Module 3,4,5
4	The Insider's Guide to the ARM7 Based Microcontrollers	Trevor Martin	Hitex Ltd	1st edition, 2005.	Module 1,2

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc26_cs40/preview
2. https://onlinecourses.nptel.ac.in/noc26_cs54/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	2	-	-	-
CO3	3	1	-	-	-	-	-	2	-	-	-
CO4	3	1	-	-	-	-	-	2	-	-	1
CO5	3	1	-	-	-	-	-	2	-	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	1
CO4	-	-
CO5	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24505C	Contact Hrs /week: 03
Course Description: Design Patterns		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

This course introduces the principles of object-oriented design and the use of design patterns to develop efficient, reusable, and maintainable software systems. It covers the fundamentals of design patterns, system analysis, structural and architectural patterns, and the application of object-oriented concepts in interactive and distributed environments. Through theoretical understanding and practical implementation, learners will gain the skills necessary to analyze requirements, design robust architectures, and apply appropriate design patterns in real-world software development.

2. COURSE LEVEL OBJECTIVES

CLO1	Learn How to add functionality to designs while minimizing complexity.
CLO2	What code qualities are required to maintain to keep code flexible?
CLO3	To Understand the common design patterns.
CLO4	To explore the appropriate patterns for design problems

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the basic concepts of state & behaviour of real world objects.	PO1, PO2, PO5	Understand L2	WK4, WK6	12
CO2	Apply Object Oriented Analysis and Design	PO1, PO2, PO3, PO5, PO10	Apply L3	WK4, WK6	12

	concepts to solve complex problems.				
CO3	Construct various UML models using the appropriate notation for specific problem context.	PO1, PO2, PO3, PO4, PO5, PO9, PO10, PSO1	Apply L3	WK4, WK6	10
CO4	Design models to Show the importance of systems analysis and design in solving complex problems using case studies.	PO1, PO2, PO3, PO4, PO5, PO6, PO9, PO10, PO11, PSO1	Apply L3	WK4, WK6	10
CO5	Study of Pattern Oriented approach for real world problems.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11	Apply L3	WK4, WK6	12

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Module-1: Introduction: what is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. What is object-oriented development? , key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm.	CO1	12
II	Module-2: Analysis of a System: Overview of the analysis phase, stage 1: gathering the requirements -functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain. Design and Implementation	CO2	12
III	Module-3: Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy	CO3	10
IV	Module-4: Interactive systems and the MVC architecture: Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature, pattern based solutions.	CO4	10

V	Module-5: Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web (discussions and further reading) a note on input and output, selection statements, loops arrays.	CO5	12
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Object-oriented analysis, design and implementation	Brahma dathan, Sarnath rammath,	Universities press	2013	1, 2
2	Design patterns	erich gamma, Richard helan, Ralph johman , john vlissides	PEARSON Publication	2013	3
3	Pattern Oriented Software Architecture	Frank Bachmann, Regine Meunier, Hans Rohnert	John Wiley & Sons	Volume 1 1996	4, 5
4	Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis	William J Brown et al.	John Wiley	1998	5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://www.coursera.org/learn/object-oriented-analysis-and-design-foundations-and-concepts>
2. <https://www.coursera.org/learn/object-oriented-design> Co
3. <https://www.coursera.org/learn/object-oriented-analysis-and-design-patterns-and-principles>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	-
CO2	3	2	1	-	1	-	-	-	-	1	-
CO3	2	3	2	1	1	-	-	-	1	1	-
CO4	2	2	3	2	1	1	-	-	1	2	1
CO5	2	2	2	3	2	1	1	1	2	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	2	-
CO4	3	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24505D	Contact Hrs /week: 3
Course Description: Agile Technology		No. of Credits: L : T : P : S = 3:0:0:0
Course Category: PE		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

Agile Technology emerges as a transformative approach that emphasizes iterative development, collaborative teamwork, and customer-centric delivery. This course introduces students to the core principles, frameworks, and practices of Agile methodologies, with a particular focus on Extreme Programming (XP) and Scrum.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand basics of agile technologies
CLO2	To explain XP Lifecycle, XP Concepts and Adopting XP
CLO3	To apply the basic concepts on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements and Customer Tests
CLO4	To become Mastering in Agility and well Deliver Value

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Discuss the fundamentals of agile technologies	PO1, PO11, PSO2	Understand L2	WK1, WK3, WK5	08
CO2	Explain XP Lifecycle, XP Concepts and Adopting XP	PO1, PO2, PO5, PSO2	Understand L2	WK2, WK3, WK4, WK6	08

CO3	Apply different techniques on Practicing XP, Collaborating and Releasing	PO3, PO6, PO9, PO10, PSO2	Apply L3	WK4, WK6, WK7, WK9	08
CO4	Analyze the Values, Principles of Mastering and agility to deliver good values	PO4, PO8, PO11, PSO2	Apply L3	WK5, WK7, WK8, WK9	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Why Agile? : Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile?: Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor. The Genesis of Agile, Introduction and background, Agile Manifesto, and Principles, Simple Design, User Stories, Agile Testing, Agile Tools	CO1	08
II	Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us?, Go!, Assess Your Agility Overview of Extreme Programming, The Practices of Extreme Programming, Conclusion, Bibliography, Planning Initial Exploration, Release Planning, Iteration Planning, Defining "Done", Task Planning Iterating, Tracking.	CO2	08
III	Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting, Releasing: "Done Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation. Planning: Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. Developing: Incremental requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing	CO3	08

IV	Mastering Agility : Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People :Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, Eliminate Waste :Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput	CO4	08
V	Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence: Software Doesn't Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery	CO4	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The Art of Agile Development,	James shore, Chromatic, O'Reilly	O'Reilly Media, Inc.	1st	1,2,3,4,5
2	Agile Software Development with Scrum	Ken Schawber, Mike Beedle	Pearson, 2008	1st	1
3	Agile-Principles-Patterns-and-Practices-in-C	Robert C Martin & Mic Martin	Prentice Hall.	1st	2

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://www.nptelvideos.com/video.php?id=904>
2. <https://www.geeksforgeeks.org/software-engineering/software-engineering-extreme-programming-xp>
3. <https://premieragile.com/life-cycle-of-extreme-programming/>
4. <https://agility-at-scale.com/principles/pillars/>
5. <https://scrum-master.org/en/scrum-mastering-the-3-pillars-5-values-and-7-key-principles-of-agile-project-management/>


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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	-	-	2	-	-	-	-	-	-
CO3	-	-	3	-	-	3	-	-	2	2	-
CO4	-	-	-	3	-	-	-	3	-	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	3
CO4	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24556A	Contact Hrs /week: 02
Course Description: Software Design using Plant UML		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

Software Design using PlantUML focuses on modeling software systems efficiently using PlantUML, a text-based tool for creating UML diagrams. It helps in visualizing system architecture, representing use cases, class structures, and sequence flows, and producing clear, maintainable, and collaborative design documentation.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand and apply the fundamental concepts of Object-Oriented Analysis and Design (OOAD) and UML notations for modeling real-world systems using Plant UML.
CLO2	Design and analyze the behavioral aspects of software systems by developing Use Case, Sequence, Activity, and State Machine diagrams using Plant UML.
CLO3	Create, evaluate, and integrate architectural and deployment models to represent system components and interactions using Plant UML.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the principles of Object-Oriented Analysis and Design to model real-world systems using various UML diagrams in Plant UML.	PO1, PO2, PO3, PO5, PO10	Apply L3	WK1, WK2	04

CO2	Develop structural models to represent the architecture and relationships among software system components.	PO1, PO2, PO3, PO5, PO10	Apply L3	WK1, WK2	04
CO3	Construct behavioral models to capture dynamic interactions within a system.	PO1, PO2, PO3, PO5, PO10	Apply L3	WK1, WK2	10
CO4	Design component and deployment diagrams to represent system architecture and implementation environments effectively.	PO1, PO2, PO3, PO5, PO10, PSO1	Apply L3	WK1, WK2	06
CO5	Create complete software design documentation by combining multiple UML diagram types for a given case study using Plant UML tools.	PO1, PO2, PO3, PO4, PO5, PO10, PSO1	Apply L3	WK1, WK2	04

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	Create a Use Case Diagram for an Online Food Delivery System showing interactions among actors like Customer, Restaurant, and Delivery Partner.	CO1, CO3	02
2	Design a Class Diagram for a Library Management System including classes such as Book, Member, Librarian, and Transaction with appropriate relationships and multiplicities.	CO1, CO2	02
3	Draw a Sequence Diagram for a Login and Authentication Process in a web application that includes User, Browser, Web Server, and Database.	CO3	03
4	Develop an Activity Diagram for an Online Shopping Checkout Process , from adding items to cart until payment confirmation.	CO3	03
5	Construct a Component Diagram for a Banking Management System showing software components like Account Management, Transaction Processing, and Notification Service.	CO4	03
6	Design a Deployment Diagram representing the client-server architecture of a Hospital Management System , showing devices, nodes, and connections.	CO4	03

7	Create a State Diagram to model the states of an Order in an e-commerce platform (e.g., Created → Confirmed → Shipped → Delivered → Returned).	CO3	03
8	Build an Object Diagram that depicts runtime instances of classes from a Student Enrollment System , showing how specific objects relate to each other.	CO1, CO2	03
9	Design a Package Diagram for a University Management Application showing packages such as Students, Courses, Faculty, and Administration, and their dependencies.	CO2	03
10	Draw a Composite Structure Diagram for an ATM System , illustrating internal components like Card Reader, Cash Dispenser, and Transaction Processor.	CO5	03

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Topics Covered
1	UML Distilled: A Brief Guide to the Standard Object Modeling Language	Martin Fowler	Addison-Wesley	3 rd Edition	Structural & Behavioral Modeling (Class, Object, Use Case, Sequence, Activity, State Machine)
2	Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design	Craig Larman	Pearson Education	3 rd Edition	OOAD Principles, Use Case Modeling, Class Diagrams, Interaction Diagrams
3	The Unified Modeling Language User Guide	Grady Booch, James Rumbaugh, Ivar Jacobson	Addison-Wesley	2 nd Edition	Structural, Behavioral, Interaction, and Architectural UML diagrams
4	Practical UML Using PlantUML: A Step-by-Step Guide to Visual Modeling	Meera Narasimhan (or equivalent PlantUML tutorial book)	Independently Published	Latest	All UML Diagrams Using PlantUML (Syntax, modeling workflow, documentation generation)

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/learn/software-engineering-modeling-software-systems-using-uml>

2. <https://www.classcentral.com/course/freecodecamp-uml-diagrams-full-course-unified-modeling-language-104954>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	3	-	3	-	-	-	-	2	-
CO2	2	2	3	-	3	-	-	-	-	2	-
CO3	2	2	3	-	3	-	-	-	-	2	-
CO4	2	2	3	-	3	-	-	-	-	2	-
CO5	2	2	3	2	3	-	-	-	-	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24556B	Contact Hrs /week: 02
Course Description: Competitive Programming		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: C Programming, Python, Java and Data Structures		

1. PREAMBLE ABOUT THE COURSE

Competitive programming is a rigorous mental workout that sharpens logical thinking, problem-solving capabilities, and the ability to find optimal solutions quickly. It provides an excellent way to learn and implement various data structures and algorithms effectively, encouraging the design of solutions that are not just correct, but also efficient in terms of time and space complexity.

Success in this field is highly valued by top technology companies (like Google, Amazon, and Microsoft) and can significantly help in preparing for technical interviews, hackathons, Google Talent Search, ACM ICPC, and securing placements.

2. COURSE LEVEL OBJECTIVES

CLO1	Implement different programming constructs and decomposition of problems into functions
CLO2	Use and implement linear and non-linear Data Structures to obtain solutions.
CLO3	Utilize Object-Oriented Programming principles and Standard Template Library (STL) features in Java/Python to computational problems

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply foundational concepts of programming such as data types, control flow, functions,	PO1, PO2, PO3, PO5,	Apply L3	WK2	04

	and memory management to solve real-world problems.	PO7, PO8, PO9, PO11, PSO1			
CO2	Demonstrate proficiency in using pointers, arrays, structures, and dynamic memory for efficient problem-solving and algorithm implementation.	PO1, PO2, PO3, PO5, PO7, PO8, PO9, PO11, PSO1	Apply L3	WK2	07
CO3	Utilize Object-Oriented Programming principles and Standard Template Library (STL) features in Java/Python to develop modular and reusable code.	PO1, PO2, PO3, PO5, PO7, PO8, PO9, PO11, PSO1	Apply L3	WK2	06
CO4	Solve computational problems of varying complexity using structured or object-oriented approaches, and implement data structures such as linked lists, stacks, queues using C, Python or Java	PO1, PO2, PO3, PO5, PO7, PO8, PO9, PO11, PSO1	Apply L3	WK2	11

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	Data Types, Operators & Control Flow Data Types & Type Casting Operators (Arithmetic, Logical, Bitwise, Relational) Control Flow (if-else, loops, switch-case) Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO1	02
2	Functions, Recursion & Memory Management Pass by Value vs Pass by Reference Function Pointers & Callbacks Recursion (Tail & Non-Tail), Stack Memory Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO1	02

3	Pointers, Arrays & Strings Pointer Arithmetic & Dynamic Memory (malloc, calloc, free) 2D Arrays & String Manipulation (strcpy, strcmp) Pointer to Arrays & Array of Pointers Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO2	02
4	Structures, Unions & File Handling Structures & Unions (Bit Fields, Memory Allocation) File Handling (fopen, fclose, fread, fwrite) Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO2	02
5	Linked Lists in C Single, Double, Circular Linked Lists Dynamic Memory Allocation & Linked List Operations Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO2	03
6	STL - Stacks, Queues & Priority Queues Stack (LIFO), Queue (FIFO), Deque Priority Queue & Min/Max Heaps Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO3	03
7	Linked Lists, Binary Trees, Stacks & Queues Implementing Linked Lists using STL Implementing Stack & Queue. Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO3	03
8	String Matching Palindrome Check Naive Pattern Searching Improved Naive Pattern Searching for Distinct Rabin Karp Algorithm Ordered & Unordered Maps Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO4	03
9	Performance analysis of Sorting and Searching Binary Search (Recursive) Insertion Sort Selection Sort Quick Sort Merge Sort Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO4	04
10	Number Theory Factorial Fibonacci Numbers Prime number- Sieve concept Extended Euclidean Algorithm nCr Binomial Coefficient Modular Exponentiation Scenario-Based Problems: 2 Easy, 2 Medium, 2 Hard	CO4	04

Note:

1. Low Level (Easy)

The questions focus on a programmer's ability to translate a simple idea into code without needing advanced mathematical insights or complex data structures.

- **Core Focus:** Basic implementation, brute force, and simple logic.
- **Common Topics:** Arrays, strings, basic loops, sorting, and simple math (like checking if a number is even/odd).
- **Key Characteristics:**
Direct problem statements with little ambiguity.
Can often be solved in under 10–15 minutes by an experienced coder.
Tests your familiarity with a language's basic syntax rather than deep algorithmic knowledge.

2. Medium Level

Medium questions require you to identify the correct algorithm or data structure to meet specific performance constraints.

- **Core Focus:** Optimization and efficient problem-solving.
- **Common Topics:** Binary search, hashing, greedy algorithms, basic dynamic programming (DP), and graph traversals (BFS/DFS).
- **Key Characteristics:**
Usually involves multiple edge cases that can lead to "Wrong Answer" (WA).
A brute-force solution will likely exceed the time limit (TLE), requiring a more performant approach.
Equivalent to Codeforces Div2 B or C level problems

3. High Level (Hard)

High-level questions often combine multiple complex concepts or require original mathematical derivations.

- **Core Focus:** Advanced algorithms and "out of the box" thinking.
- **Common Topics:** Advanced DP (tree DP, bitmask DP), segment trees, network flow, heavy graph algorithms (Dijkstra's, MST), and Fast Fourier Transform (FFT).
- **Key Characteristics:**
Often require multiple data structures or algorithms to work in tandem (e.g., DFS with memoization and backtracking).
The problem statement might be abstract, requiring you to model a real-world scenario into a specific data structure.
Solutions can be equivalent to Codeforces Div2 D/E or Div1 problems.



5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition
1	Data Structures and Algorithms Made Easy	Narasimha Karumanchi	Careermonk Publications	5 th Edition 2016
2	Automate the Boring Stuff with Python	Al Sweigart,	Create Space Independent Publishing Platform	1 st Edition 2015
3	Java: The Complete Reference	Herbert Schildt, Dr. Danny Coward	McGraw Hill	13 th Edition 2024
4	Competitive Programming 4 - Book 1: The Lower Bound of Programming Contests in the 2020s	Steven Halim, Felix Halim, Suhendry Effendy	Lulu.com	1 st Edition 2018

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc22_cs59/preview
2. <https://media.geeksforgeeks.org/courses/syllabus/81a49c8bc27517b0fc45101294625b29.pdf>
3. <https://gist.github.com/sharmaeklavya2/8aa2830f3a46a3f46ff249b4e1f07767>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	3	-	2	-	2	2	2	-	2
CO2	2	3	3	-	2	-	2	2	2	-	2
CO3	2	3	3	-	2	-	2	2	2	-	2
CO4	2	3	3	-	2	-	2	2	2	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24556C	Contact Hrs /week: 02
Course Description: Full Stack Framework (Backend)		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: JavaScript, HTML		

1. PREAMBLE ABOUT THE COURSE

The Full Stack Framework (Backend) course equips students with the core skills required to design, develop, and deploy scalable and secure backend applications using modern JavaScript technologies. The course focuses on Node.js, Express.js, and MongoDB to build efficient server-side applications and RESTful APIs. Students gain hands-on experience in backend server development, database integration, authentication and authorization using JWT, and performance optimization techniques such as filtering, pagination, and sorting. By the end of the course, learners will be able to develop industry-ready backend systems following best practices and modern development standards.

2. COURSE LEVEL OBJECTIVES

CLO1	Demonstrate the ability to install and configure Node.js and Visual Studio Code, and understand the basic concepts and benefits of using Node.js in modern web development
CLO2	Design and implement an Express server that can serve static assets, HTML, and JSON, and understand the principles of routing and middleware in Express applications.
CLO3	Set up a MongoDB database, create Mongoose models, and develop RESTful API endpoints for creating, reading, updating, and deleting resources, with appropriate data validation and sanitization.
CLO4	Apply best practices for securely storing passwords, use JSON Web Tokens (JWT) for authentication, and protect API endpoints with middleware to ensure data security and user privacy
CLO5	Apply techniques for sorting, filtering, and paginating data to manage large datasets effectively and ensure efficient data retrieval in web applications.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Install Node.js and Visual Studio Code, understand the role of Node.js in web development, and write and execute basic Node.js scripts	PO1, PO5, PO11, PSO1	Apply L3	WK3, WK4, WK6	03
CO2	Set up an Express server, serve static files, and handle HTTP requests for different content types, including HTML, JSON, CSS, JS, and images	PO2, PO3, PO5, PO9, PSO1	Apply L3	WK3, WK4, WK6	03
CO3	Install MongoDB, setting up Mongoose, and performing CRUD operations using a RESTful API with proper data validation and sanitization	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK6	06
CO4	Securely handle user authentication, including password management, JWT generation and validation, and implementing middleware for protecting API routes.	PO1, PO3, PO5, PO7, PO8, PO9, PSO1	Apply L3	WK4, WK6, WK7, WK9	06
CO5	Implement effective data management strategies, including sorting, filtering, and paginating data to enhance application performance and user experience.	PO2, PO3, PO4, PO5, PO10, PO11, PSO1, PSO2	Apply L3	WK2, WK4, WK6, WK8	06

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

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4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
I	MODULE 1 Installing and Exploring Node.js: Installing Node.js and Visual Studio Code, What is Node.js? Why Should I Use Node.js? Your First Node.js Script	CO1	24
II	MODULE 2 Web Server: Hello Express!, Serving up HTML and JSON, Serving up Static Assets, Serving up CSS, JS and Images	CO2	
III	MODULE 3 MongoDB and REST APIs: Installing MongoDB on Windows, Setting up Mongoose, Creating a Mongoose Model, Data Validation and Sanitization, Structuring a REST API, Installing Postman, Resource Creation Endpoints, Resource Reading Endpoints, Resource Updating Endpoints, Resource Deleting Endpoints	CO3	
IV	MODULE 4 API Authentication and Security: Securely Storing Passwords, Logging in Users, JSON Web Tokens, Generating Authentication Tokens, Express Middleware, Accepting Authentication Tokens, Logging Out, Hiding Private Data, Authenticating User Endpoints	CO4	
V	MODULE 5 Sorting, Pagination, and Filtering: Filtering Data, Paginating Data, Sorting Data	CO5	

List of Experiments

Program 1: Basic Node.js Setup and Script

Objective:

Install Node.js, verify setup, and create your first Node.js script.

Tasks:

1. Install Node.js and verify using `node -v` and `npm -v`.
2. Initialize a project using `npm init -y`.
3. Create `hello.js` that prints "Hello, Node.js!".
4. Run using `node hello.js`.



Program 2: Express Server with HTML, JSON & Static Files

Objective:

Set up a basic Express server to serve HTML, JSON, and static assets.

Tasks:

1. Install Express and create app.js.
2. Add routes:
 - / → Respond with "Hello, Express!"
 - /api/data → Return sample JSON.
3. Create a public folder with:
 - index.html
 - css/style.css
 - js/script.js
 - images/logo.png
4. Configure Express to serve static files from /public.

Program 3: MongoDB Connection and Mongoose Model

Objective:

Connect to MongoDB and define a Mongoose model.

Tasks:

1. Install express, mongoose, and body-parser.
2. Create an Item model with fields: name, category, price.
3. Add validation for required and positive values.

Program 4: CRUD REST API Implementation

Objective:

Implement REST endpoints for Create, Read, Update, and Delete operations.

Tasks:

1. Add routes:
 - POST /api/items → Create item
 - GET /api/items → Get all items
 - GET /api/items/:id → Get item by ID
 - PUT /api/items/:id → Update item
 - DELETE /api/items/:id → Delete item
2. Test all endpoints using **Postman**.

Program 5: User Registration with Password Hashing

Objective:

Implement secure user registration using password hashing.



Tasks:

1. Create User model with fields username, email, password.
2. Use bcrypt to hash password before saving.
3. Add POST /api/register route for registration.

Program 6: Login and JWT Authentication**Objective:**

Implement user login and token-based authentication using JWT.

Tasks:

1. Add POST /api/login route to authenticate users.
2. Generate JWT using jsonwebtoken.
3. Create middleware to verify tokens for protected routes.
4. Add /api/profile route accessible only with valid JWT.

Program 7: Filtering and Pagination**Objective:**

Implement query-based filtering and pagination.

Tasks:Create /api/items GET endpoint.

1. Apply filters:
 - Category: ?category=electronics
 - Price range: ?minPrice=100&maxPrice=1000
2. Add pagination using:
 - Page: ?page=2
 - Limit: ?limit=10

Program 8: Sorting and Combined Queries**Objective:**

Add sorting and combine all features (filter, paginate, sort).

Tasks:

1. Add sort parameter:
 - Ascending: ?sort=price
 - Descending: ?sort=-createdAt
2. Handle combined queries like:
/api/items?category=books&minPrice=100&maxPrice=500&page=1&limit=5&sort=-createdAt
3. Return filtered, paginated, and sorted results.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The Complete Node.js Developer Course	Andrew Mead, Rob Percival	Packt Publishing, ISBN: 9781789955071	3rd	1,2,3,4,5
2	Beginning Node.js	Basarat Ali Syed	Apress	1st	1,2
3	Node.JS Web Development	David Herron	Packt Publishing	1st	3,4
4	Node.js Design Patterns	Mario Casciaro	Packt Publishing	1st	5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.anuragkapur.com/assets/blog/programming/node/PDF-Guide-Node-Andrew-Mead-v3.pdf>
2. <https://www.udemy.com/course/the-complete-nodejs-developer-course-2/?couponCode=ST10MT8624>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	2	-	-	-	-	-	2
CO2	-	2	3	-	2	-	-	-	1	-	-
CO3	3	2	3	2	2	-	-	-	-	-	-
CO4	2	-	3	-	2	-	2	1	1	-	-
CO5	-	2	2	2	2	-	-	-	-	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	3
CO4	3	-
CO5	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

Department: Computer Science and Engineering		
Semester: V	Course Code: BCS24556D	Contact Hrs /week: 02
Course Description: Automated Software Testing with TOSCA		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

This course introduces students to modern test automation practices using **Tricentis Tosca**, a widely adopted continuous testing platform. With the increasing complexity of software systems and the demand for rapid, high-quality releases, automated testing has become a critical skill for software professionals. This course provides a comprehensive understanding of model-based test automation, test case design, test execution, and reporting using Tosca's industry-standard tools and methodologies. Students will learn to create robust, maintainable automated tests across web, mobile, and enterprise applications, integrate Tosca with CI/CD pipelines, and apply risk-based testing strategies for optimized test coverage. By the end of the course, learners will be equipped with practical skills and hands-on experience to implement scalable automated testing solutions in real-world software development environments.

2. COURSE LEVEL OBJECTIVES

CLO1	Learn the fundamentals of automation testing
CLO2	Design automated test cases
CLO3	Perform test executions on different browsers.
CLO4	Get an overview of test case designs and modules used in Tosca automation tool.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply Tosca Commander tools and techniques to design and execute automated test	PO1, PO2, PO3, PO5, PSO1	Apply L3	WK1, WK2	02

	cases for web and desktop applications.				
CO2	Develop reusable and modular test artifacts, including test steps, templates, and data-driven test cases, to improve automation efficiency.	PO1, PO2, PO3, PO5, PSO1	Apply L3	WK1, WK2	05
CO3	Analyze and automate complex functional workflows, API services, and business processes using Tosca modules and templates.	PO1, PO2, PO3, PO4, PO5, PSO1	Apply L3	WK1, WK2	09
CO4	Analyze and evaluate testing scenarios using risk-based testing, cross-browser testing, and CI/CD integration to enhance test coverage and effectiveness.	PO1, PO2, PO3, PO4, PO5, PSO1	Apply L3	WK1, WK2	09
CO5	Integrate UI, API, and data-driven tests to create comprehensive automated test suites, demonstrating end-to-end test automation capabilities.	PO1, PO2, PO3, PO4, PO5, PSO1	Apply L3	WK1, WK2	03

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	Create and Execute a Basic Test Case in Tosca: Apply Tosca Commander to design and run a simple automated test case on a sample web application.	CO1	02
2	Develop a Reusable Test Step Library: Design modular reusable test steps in Tosca for login functionality of a sample application.	CO2	02
3	Automate Data-Driven Testing: Implement test cases using Tosca's TestCase Template and TestSheet to perform data-driven testing for form validation.	CO2	03
4	Perform API Testing with Tosca API Scan:	CO3	03

	Design and execute automated API test cases for REST and SOAP services using Tosca API modules.		
5	Integrate Tosca with Test Data Management (TDM): Configure Tosca TDM to fetch, create, and manage test data dynamically during test execution.	CO3	03
6	Execute Cross-Browser Testing: Set up and perform automated web tests on multiple browsers using Tosca ExecutionList and ExecutionSets.	CO4	03
7	Design a Test Case for a Business Process Workflow: Automate an end-to-end process (e.g., Order Placement → Payment → Confirmation) using Tosca's process modules.	CO3	03
8	Implement Risk-Based Testing (RBT): Create risk assessments, assign weights, and generate optimized test cases based on Tosca's RBT approach.	CO4	03
9	Integrate Tosca with CI/CD (Jenkins): Configure continuous testing by integrating Tosca with Jenkins to trigger automated test suites on build completion.	CO4	03
10	Develop a Complete Automation Suite: Design, organize, and execute a full-fledged Tosca automation suite combining UI, API, and data tests for a given project scenario.	CO5	03

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	TOSCA Automation: A Complete Guide	Gerardus Blokdyk	5STARCooks	1st	All
2	Tricentis Tosca Test Automation Tools & Techniques	(EDUCBA)	EDUCBA eLearning	–	All
3	Mastering Tricentis Tosca Test Automation	Koenig Solutions (course-book)	Koenig Solutions	–	All
4	Tricentis Tosca — a Test Automation Expert's Guide (2025)	Ajay Bongani	Medium / Self-published	1st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://academy.tricentis.com/>
2. <https://www.udemy.com/course/udemy-tricentis-tosca-automation-tool-from-beginn-125354>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	3	-	-	-	-	-	-
CO2	3	2	3	-	3	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-
CO4	3	3	2	2	3	-	-	-	-	-	-
CO5	3	3	3	2	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: V	Course Code: BCSP24507	Contact Hrs /week: 04
Course Description: Mini Project		No. of Credits: 02 L : T : P : S = 0:0:4:0
Course Category: MINI PROJECT		Total no. of Hours = 28
CIE: 100 Marks	SEE: -	Exam Hours: 02
Course Pre-requisites: DS, DBMS, OOP, Web Technologies		

1. PREAMBLE ABOUT THE COURSE

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 2 students.

2. COURSE LEVEL OBJECTIVES

CLO1	Identify and define a real-world problem and formulate appropriate project objectives and requirements.
CLO2	Design a feasible solution using suitable algorithms, system architecture, and technologies.
CLO3	Implement and test the proposed solution using appropriate programming languages, tools, and platforms.
CLO4	Work effectively as a team member, demonstrating collaboration, responsibility, and professional ethics.
CLO5	Document the project and communicate technical ideas clearly through reports, presentations, and demonstrations.
CLO6	Analyze project outcomes, evaluate limitations, and suggest future enhancements.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK
CO1	Apply theoretical knowledge from core computer science subjects to solve a real-world or practical problem.	PO1, PO2, PO3, PSO1, PSO2	Apply L3	WK3

CO2	Understand the software/hardware development lifecycle , including problem identification, requirement analysis, design, implementation, testing, and documentation.	PO2, PO3, PO11, PSO1, PSO2	Apply L3	WK4
CO3	Develop teamwork and communication skills by working in groups and presenting technical work effectively.	PO9, PO10, PO11, , PSO1, PSO2	Apply L3	WK3
CO4	Gain hands-on experience with modern tools, technologies, and programming platforms relevant to current industry practices.	PO3, PO5, PSO1, PSO2	Apply L3	WK3
CO5	Cultivate problem-solving, critical thinking, and self-learning abilities required for larger projects and internships.	PO2, PO11, , PSO1, PSO2	Apply L3	WK6

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK94.

4. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	3	-	-	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	3	-	3	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

5. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

6. EVALUATION METHODOLOGY

- (i) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.
- (ii) **Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini Project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

CIE Evaluation		
Components	Explanation	
Review 1	Presentation Skills: 25 + Q & A: 25 = 50	50
Review 2	Presentation Skills: 25 + Q & A: 25 = 50	50
Average of Review 1 and Review 2		50
Mini Project Report		50
TOTAL MARKS		100



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Department: Computer Science and Engineering		
Semester: V	Course Code: BRMK24557	Contact Hrs /week: 03
Course Description: Research Methodology and IPR		No. of Credits: 03 L : T : P : S = 2:2:0:0
Course Category: AEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basic Statistics and Probability, Ethics in Science and Technology		

1. PREAMBLE ABOUT THE COURSE

This course is designed to equip students with essential skills for conducting systematic and high-quality research while understanding the legal frameworks that protect intellectual property. It introduces the fundamentals of research, including formulation of research problems, literature review, research design, data collection, analysis, and interpretation of results. Additionally, the course provides a comprehensive overview of **Intellectual Property Rights**, covering patents, copyrights, trademarks, industrial designs, and related legal and ethical considerations. By integrating research methodology with IPR knowledge, students gain the ability to design and execute research projects responsibly, protect their innovations, and navigate ethical and legal issues in academia and industry. This course is aimed at fostering analytical thinking, innovation, and scholarly integrity among students pursuing higher education and research in engineering, science, and technology.

2. COURSE LEVEL OBJECTIVES

CLO1	To make the student understand the foundations of Research and problem solution
CLO2	Knowledge in Research design, Qualitative and Quantitative Research
CLO3	Knowledge to formulate and derive static and dynamic aero elastic equations of motion.
CLO4	To understand the different types of IPR

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply fundamental research methodology concepts, including types, processes, and problem formulation, to initiate a research study.	PO1	Apply L3	WK8, WK1, WK2	10
CO2	Use appropriate techniques to conduct literature reviews and develop theoretical/conceptual frameworks in line with academic standards	PO2	Apply L3	WK2, WK8	11
CO3	Investigate research problems using proper sampling, data collection, and hypothesis testing procedures	PO4	Apply L3	WK8, WK9	12
CO4	Present a structured review manuscript while adhering to IPR, ethical standards, and teamwork principles.	PO8, PO9, PO11	Apply L3	WK9, WK8	09

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining The Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration	CO1	07
II	Reviewing The Literature: Place of the literature review in research, bringing clarity and focus to research problem, improving research methodology, broadening knowledge base in research area, enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework,	CO2, CO4	08

	developing a conceptual framework, writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.		
III	Design Of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement And Scaling: Qualitative and Quantitative Data, Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.	CO1, CO3	10
IV	Testing Of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Interpretation And Report Writing: Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	CO3, CO4	09
V	Intellectual Property: Principles of IPR, Kinds of IPR, Patent- Concepts, Novelty, Utility Inventiveness/Non-obviousness, Procedure for granting and obtaining patents; Copyright- conditions for grant of copyright, Copyright in Literary, Dramatic and Musical ,Works, Sound Recording, Cinematograph Films, Copyright in Computer Programme, Author Special Rights, Right of Broadcasting and performers, Trademark Law and Practices - Procedure of registration of trademark; Emerging Issues and Challenges; Few Future Aspects of Intellectual Property Rights;	CO2, CO4	08

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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Research Methodology: Methods and Techniques.	Kothari, C.R., 1990	New Age International. 418p.	4 th	M1, M2, M3, M4,
2	Business Research Methods	Donald Cooper & Pamela Schindler	TMGH	9 th	M1, M2, M3
3	Business Research Methods	Alan Bryman & Emma Bell	Oxford University Press.	-	M1, M2, M3
4	Intellectual Property Law	Lionel Bently	TMGH	3 rd	M5
5	Law relating to patents	Wadehra, B	Oxford University Press	3 rd	M5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/learn/research-methodologies>
2. <https://www.youtube.com/@introductiontoresearch-i1586>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	2	2	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Civil Engineering		
Semester: V	Course Code: BESK24508	Contact Hrs /week: 01
Course Description: Environmental Studies		No. of Credits: 00 L : T : P : S = 1:0:0
Course Category: NCMC		Total no. of Hours = 15
CIE: 100 Marks	SEE: 0 Marks	Exam Hours: 0
Course Pre-requisites: Basic science and foundational knowledge in environmental issues		

1. PREAMBLE ABOUT THE COURSE

This course introduces fundamental concepts of Environmental Studies, emphasizing ecosystem dynamics, natural resources, pollution control, global environmental issues, sustainability, and environmental legislation. It aims to develop environmental awareness, promote responsible decision-making, and encourage sustainable practices essential for addressing contemporary environmental challenges.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand environmental concepts, multidisciplinary nature, sustainability principles and Sustainable Development Goals.
CLO2	Explain ecosystem structure, energy flow, ecological succession and major terrestrial and aquatic ecosystems
CLO3	Evaluate water resources availability, quality aspects and renewable and non-renewable energy sources
CLO4	Analyze environmental pollution sources, impacts, prevention measures, disaster management and global environmental issues.
CLO5	Interpret environmental legislation and apply waste management, e-waste management and environmental responsibility.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain environmental fundamentals, sustainability concepts and Sustainable Development Goals.	PO1, PO6, PSO1, PSO3	L2	WK1	03

CO2	Describe ecosystem structure, energy flow and major terrestrial and aquatic ecosystems.	PO1, PO7, PSO1, PSO3	L2	WK1	03
CO3	Evaluate natural resources including water resources and conventional and renewable energy sources.	PO1, PO2, PO7, PSO1, PSO2, PSO3	L3	WK2	03
CO4	Analyze environmental pollution sources, impacts, control measures and global environmental concerns.	PO1, PO2, PO4, PO6, PO7, PSO1, PSO3	L4	WK3	03
CO5	Interpret environmental legislation and apply waste management and e-waste management practices responsibly.	PO6, PO7, PO8, PO9, PSO1, PSO2, PSO3	L3	WK3	03

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Environmental Studies: Multidisciplinary nature of environmental studies, Scope and importance; Concept of sustainability and sustainable development, SDG Goals Ecosystem: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Types of ecosystem: Terrestrial and Aquatic ecosystems.	CO1	03
II	Natural Resources: Water resources – Availability & Quality aspects, Energy: Different types of energy, Conventional sources & non-conventional sources of energy, Solar energy, OTEC, Wind Energy, Hydrogen energy. Sustainable Mining and Carbon Trading.	CO2	03
III	Environmental Pollution: Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts and Case-studies: Types of pollution. Waste Management: Industrial and Municipal Solid Waste Management, types and sources, functional elements of SWM. Biomedical Waste Management, E-Waste Sources, characteristics and its treatment and disposal.	CO3	03
IV	Global Environmental Concerns: Ground water depletion/recharging, Climate Change, Acid Rain, Ozone Depletion. Resettlement and rehabilitation of people, Environmental Toxicology	CO4	03
V	Environmental Legislation and relevant Acts: Water Act 1974, Air Act 1981, Environmental Protection Act 1984, Solid	CO5	03

	Waste Management Rules-2016, E- Waste management Rule - 2022, Biomedical Waste management- 2016		
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

SL. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Environmental Studies	S. M. Prakash	Elite Publishing House, Mangalore	3 rd Edition, 2018	1,2,3,4,5
2	Environmental Studies	Erach Bharucha	UGC/National Book Trust	2004	1,2,3,4
3	Environmental Studies	Benny Joseph	Tata McGraw-Hill	2005	1,2,3,4,5
4	Environmental Studies: From Crisis to Cure	R. Rajagopalan	Oxford University Press, New Delhi	2 nd Edition, 2013	1,2,3,4
5	Principles of Environmental Science and Engineering	Raman Sivakumar	Cengage Learning, Singapore	2 nd Edition, 2005	2,3,4
6	Electronic Waste Management: Science	Hester R.E., and Harrison R.M.	Royal Society of Chemistry	2009	5
7	E-waste: Implications, Regulations, and Management in India and Global Best Practices	R. Johri	TERI Press, New Delhi	1 st Edition	5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- NPTEL: Environmental Science : https://onlinecourses.nptel.ac.in/noc23_hs155/preview
- Sustainable Goals: <https://sdgs.un.org/goals>
- Karnataka State pollution Board: <https://kspcb.karnataka.gov.in/waste-management/biomedical-waste>


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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	2	-	-	-	-	-
CO2	3	-	-	-	-	-	2	-	-	-	-
CO3	2	2	-	-	-	-	2	-	-	-	-
CO4	2	3	-	1	-	2	3	-	-	-	-
CO5	-	-	-	-	-	3	2	2	1	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2	PSO3
CO1	2	-	2
CO2	2	-	3
CO3	3	1	3
CO4	2	-	3
CO5	1	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Science and Humanities		
Semester: III to VI	Course Code: BNSK24559	Contact Hrs /week: 02
Course Description: National Service Scheme (NSS)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

3. SYLLABUS

Module No.	Module Description
I	National Service Scheme (NSS) – Contents 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum 5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	



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Department: Science and Humanities		
Semester: III to VI	Course Code: BPEK24559	Contact Hrs /week: 02
Course Description: Physical Education (Sports & Athletics)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Lifestyle B. Health & Wellness C. Pre-Fitness test.	04
II	A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash	04
III	1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	16

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Department: Science and Humanities		
Semester: III to VI	Course Code: BYOK24559	Contact Hrs /week: 02
Course Description: Yoga		No. of Credits: L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100	SEE: -	Exam Hours: -

1. SYLLABUS

Course Title	Content
introduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its meaning, definitions. Different schools of yoga, importance of prayer
Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health.
Rules and regulations	Rules to be followed during yogic practices by practitioner.
Misconceptions of yoga	Yoga its misconceptions
Suryanamaskara	Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.
Different types of Asanas Sitting 1. Padmasana 2. Vajrasana Standing 1. Vrikshana 2. Trikonasana Prone line 1. Bhujangasana 2. Shalabhasana Supine line 1. utthitadvipadasana 2. Ardhalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits.

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Department: Science and Humanities		
Semester: III to VI	Course Code: BLAK24559	Contact Hrs /week: 02
Course Description: Music		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 24
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discuss the Indian system of music and relate it to other genres (Cognitive Do main)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	03
II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	03

III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	03
IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	3
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	4

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramaniam	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24601	Contact Hrs /week: 04
Course Description: Machine Learning		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Python Programming		

1. PREAMBLE ABOUT THE COURSE

Machine Learning is a key area of artificial intelligence that focuses on enabling systems to learn from data and make intelligent decisions without explicit programming. This course introduces the fundamental concepts, types, and applications of machine learning along with its relationship to allied fields such as data science and statistics. It emphasizes understanding data, multivariate analysis, and dimensionality reduction techniques for effective model building. The course further covers similarity-based learning, regression analysis, decision tree models, and Bayesian learning for supervised learning tasks. Unsupervised learning through clustering techniques and reinforcement learning using Q-learning are also introduced. Overall, the course equips students with essential analytical skills and practical knowledge to solve real-world engineering problems using machine learning methods.

2. COURSE LEVEL OBJECTIVES

The course will enable students to:

CLO1	To understand the basic theory underlying machine learning, types, and the process.
CLO2	To become familiar with data and visualize univariate, bivariate, and multivariate data using statistical techniques and dimensionality reduction
CLO3	To understand various machine learning algorithms such as similarity-based learning, regression, decision trees, and clustering.
CLO4	To familiarize with learning theories, probability-based models, and reinforcement learning, developing the skills required for decision-making in dynamic environments.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Demonstrate the need for machine learning, its relationship to other fields, and different types of machine learning	PO1, PO2, PO3, PO5, PSO1, PSO2	Understand L2	WK1-WK4	08
CO2	Illustrate the fundamental principles of multivariate data and apply dimensionality reduction techniques.	PO1, PO2, PO3, PO5, PSO1, PSO2	Apply L3	WK1-WK4	08
CO3	Apply similarity-based learning methods and perform linear, polynomial regression analysis	PO1, PO2, PO3, PO5, PSO1, PSO2	Apply L3	WK1-WK6	08
CO4	Apply decision trees for classification and regression problems, and Bayesian models for probabilistic learning	PO1, PO2, PO3, PO5, PSO1, PSO2	Apply L3	WK1-WK6	08
CO5	Analyze the clustering algorithms and reinforce their understanding by applying Q-learning for decision making tasks	PO1, PO2, PO3, PO5, PSO1, PSO2	Apply L3	WK1-WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Machine Learning: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Application. Understanding Data: Introduction, Big Data Analytics and Types of Analytics, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data.	CO1	08
II	Understanding Data: Multivariate Statistics, Essential Mathematics for Multivariate Data, Overview of Hypothesis,	CO2	08

	Feature Engineering and Dimensionality Reduction Techniques. Basics of Learning Theory: Introduction to Learning and its Types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modelling in Machine Learning.		
III	Similarity-based Learning: Introduction to Similarity or Instance-based Learning, Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). Regression Analysis: Introduction to Regression, Introduction to Linearity, Correlation, and Causation, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression.	CO3	08
IV	Models Based on Decision Trees: Introduction to Decision Tree, Decision Tree for Classification, Impurity Measures for Decision Tree Construction, Properties of Decision Tree Classifier (DTC), Applications in Breast Cancer Data, Regression Based on Decision Tress. Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model.	CO4	08
V	Clustering: Introduction to Clustering, Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering. Reinforcement Learning: Overview and Scope of Reinforcement Learning, Components of Reinforcement Learning, Q-Learning.	CO5	08

List of Programs

Sl. No.	Program Description
1	Develop a program to create histograms for all numerical features and analyze the distribution of each feature. Generate box plots for all numerical features and identify any outliers. Use California Housing dataset. Textbook 1: Chapter 2
2	Develop a program to Compute the correlation matrix to understand the relationships between pairs of features. Visualize the correlation matrix using a heatmap to know which variables have strong positive/negative correlations. Create a pair plot to visualize pairwise relationships between features. Use California Housing dataset. Textbook 1: Chapter 2

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3	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2. Textbook 1: Chapter 2
4	For a given set of training data examples stored in a .CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples. Textbook 1: Chapter 3
5	Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of $[0,1]$. Perform the following based on dataset generated. a. Label the first 50 points $\{x_1, \dots, x_{50}\}$ as follows: if $(x_i \leq 0.5)$, then $x_i \in \text{Class1}$, else $x_i \in \text{Class2}$ b. Classify the remaining points, $x_{51}, \dots, x_{100}$ using KNN. Perform this for $k=1,2,3,4,5,20,30$. Textbook 2: Chapter – 2
6	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. Textbook 1: Chapter – 4
7	Develop a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression. Textbook 1: Chapter – 5
8	Develop a program to demonstrate the working of the decision tree algorithm. Use Breast Cancer Data set for building the decision tree and apply this knowledge to classify a new sample. Textbook 2: Chapter – 3
9	Develop a program to implement the Naive Bayesian classifier considering Olivetti Face Data set for training. Compute the accuracy of the classifier, considering a few test data sets. Textbook 2: Chapter – 4
10	Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result. Textbook 2: Chapter – 4

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Machine Learning	. S Sridhar and M Vijayalakshmi	Oxford University Press	2021	1, 2 and 3
2	Machine Learning: Theory and Practice	M N Murty and Ananthanarayana V S	Universities Press (India) Pvt. Limited,	2024	4 and 5
3	Machine Learning	Tom M. Mitchell	McGraw-Hill Education	2013	-

4	An Introduction to Machine Learning	Miroslav Kubat	Springer	2017	-
5	Machine Learning	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das	Pearson Publisher	Fifth Edition 2020	-
6	Introduction to machine learning	Ethem Alpaydin	PHI publication	Second edition 2010	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2. <https://www.geeksforgeeks.org/machine-learning/machine-learning/>
3. https://www.drssridhar.com/?page_id=1053
4. <https://www.universitiespress.com/resources?id=9789393330697>
5. <https://www.geeksforgeeks.org/machine-learning/machine-learning/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	2	-	-	-	-	-	-
CO2	3	3	2	-	2	-	-	-	-	-	-
CO3	3	3	3	-	3	-	-	-	-	-	-
CO4	3	3	3	-	2	-	-	-	-	-	-
CO5	3	3	2	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	3	2
CO2	2	3
CO3	3	3
CO4	3	3
CO5	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24602	Contact Hrs /week: 03
Course Description: Cloud Computing and Big Data Analytics		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Computer Networks, Data Base Management System		

1. PREAMBLE ABOUT THE COURSE

The Cloud Computing and Big Data Analytics course helps students understand the basics of cloud computing, including cloud types, virtualization, and service models. It introduces popular cloud platforms like AWS, Azure, and Google Cloud, and explains how they work. Students will also learn about NoSQL databases like MongoDB and Cassandra, and how to process big data using tools like Hadoop and MapReduce.

2. COURSE LEVEL OBJECTIVES

CLO1	To introduce the fundamental concepts, architecture, and service models of cloud computing.
CLO2	To familiarize students with virtualization technologies and deployment models used in cloud infrastructure.
CLO3	To explain big data characteristics and processing frameworks such as Hadoop and MapReduce.
CLO4	To familiarize students with the concepts of NoSQL databases using MongoDB and Cassandra in the context of Big Data.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Articulate the fundamental concepts of cloud computing and virtualization technologies.	PO1, PO2	Apply L3	WK1	08

CO2	Compare basic features of AWS, Microsoft Azure, and Google Cloud.	PO1, PO2, PO5	Apply L3	WK1, WK8	06
CO3	Discuss key features of leading cloud platforms like AWS, Azure, and Google Cloud.	PO1, PO2, PO5	Apply L3	WK6, WK8	06
CO4	Illustrate big data principles, Hadoop ecosystem, and MapReduce framework.	PO1, PO2, PO5	Apply L3	WK1, WK8	06
CO5	Create a solution using NoSQL databases like MongoDB and Cassandra to support big data analytics.	PO1, PO2, PO5, PSO2	Apply L3	WK6, WK8	06

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Defining cloud computing, cloud types, examining the Characteristics of cloud Computing Historical Developments, Virtualization, introduction, characteristics of virtualized Environments, Virtualization, Taxonomy of Techniques, Execution Virtualization, pros and Cons of virtualization, Technology Examples: VMware: Full virtualization	CO1	08
II	Cloud Computing Architecture: Introduction, cloud reference model, architecture infrastructure/ Hardware as a service, platform as a service, software as a service, Types of Clouds, public Clouds, private Clouds, Hybrid clouds, community clouds, Economics of the cloud, open challenges, Cloud Definition, cloud interoperability and standards scalability and Fault Tolerance, security, Trust, and privacy organizational Aspects, Aneka application framework overview.	CO2	08
III	Case Study on Open Source & Commercial Clouds: Amazon AWS, Google Cloud, Microsoft Azure Using Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2), Working with Amazon Storage Systems, Understanding Amazon Database services, Google App Engine, Architecture and core concepts, Application Life-	CO3	08

	Cycle, Cost Model, Developers, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance, CRM and ERP.		
IV	Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing. Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, Map Reduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools	CO4	08
V	NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Stores, NoSQL to Manage Big Data, MongoDB, Databases, Cassandra Databases. Map Reduce, Hive and Pig: Introduction, Map Reduce Map Tasks, Reduce Tasks and Map Reduce Execution, Composing Map Reduce for Calculations and Algorithms, Hive, HiveQL	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing, Inc.	2011	
2	Cloud Computing	Dr. Kumar Saurabh,	Wiley India	2011	
3	Mastering Cloud Computing, Tata,	Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi	McGraw Hill Education Private Limited	2013	1, 2, 3
4	<i>Microservices and Containers,</i>	Parminder Singh Kocher,	Addison Wesley,	2018	
5	<i>Moving to the Cloud</i>	Dinkar Sitaram, Geetha Manjunath	Elsevier Publications,	2011	
6	Big data and Analytics	Seema Acharya and Subhashini Chellappan	Wiley India Publishers	2nd Edition, 2019	
7	Big Data Analytics, Introduction to Hadoop, Spark and Machine Learning	Rajkamal and Preeti Saxena	McGraw Hill Publication,	2019	4,5

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6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. NPTEL Course – Cloud Computing, By Prof. Soumya Kanti Ghosh, IIT Kharagpur.
https://onlinecourses.nptel.ac.in/noc23_cs89/preview.
2. NPTEL Course-Big Data Computing, By Prof. Rajiv Misra , IIT Patna.
https://onlinecourses.nptel.ac.in/noc20_cs92/preview

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	3	1	-	-	1	-	-	-	-	-	-
CO3	2	2	-	-	1	-	-	-	-	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-
CO5	2	1	-	-	1	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24603	Contact Hrs /week: 03
Course Description: Theory of Computation and Compiler Design		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Discrete Mathematics, Problem solving through C		

1. PREAMBLE ABOUT THE COURSE

The **Theory of Computation** and **Compiler Design** are foundational pillars in the field of computer science, closely linked by their focus on the formal aspects of programming languages and the processes that enable machines to understand and execute them. The Theory of Computation explores the fundamental capabilities and limitations of computing systems through mathematical models such as finite automata, pushdown automata, and Turing machines. It lays the groundwork for understanding what problems can be solved algorithmically and how efficiently they can be solved. On the other hand, Compiler Design builds upon these theoretical foundations to develop practical tools that translate high-level programming languages into machine-executable code. It involves multiple stages—lexical analysis, syntax analysis, semantic analysis, optimization, and code generation—each grounded in concepts from automata theory and formal languages. Together, these disciplines provide the theoretical insights and practical techniques necessary for designing efficient, correct, and robust computing systems.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand formal languages, automata, and computability to analyze the limits of computation.
CLO2	Apply grammar and parsing techniques to design language processors.
CLO3	Explore the structure and phases of a compiler from lexical analysis to code generation.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply the fundamental concepts of finite automata and Regular Expressions.	PO1, PO2, PSO1	Apply L3	WK1, WK2, WK6	08
CO2	Develop context-free grammars, parse trees, and pushdown automata for representing and processing context-free languages.	PO1, PO2, PO3, PSO1	Apply L3	WK1, WK2, WK6	08
CO3	Apply lexical analysis techniques for token specification and recognition.	PO1, PO2, PO3, PO5, PSO1	Apply L3	WK1, WK2, WK6	06
CO4	Analyze and apply different parsing strategies, including top-down and bottom-up parsing, to select appropriate syntactic analysis methods for given grammars.	PO1, PO2, PO3, PO4, PSO1	Apply L3	WK1, WK2, WK6	10
CO5	Apply intermediate code generation techniques using syntax-directed definitions to generate efficient code for specific programming constructs.	PO1, PO2, PO3, PO4, PSO1	Apply L3	WK1, WK2, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Automata Theory: Central Concepts of Automata theory, Deterministic Finite Automata(DFA), Non-Deterministic Finite Automata(NFA), Epsilon- NFA, NFA to DFA Conversion, Minimization of DFA. Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions.	CO1	08
II	Context Free Grammars: Definition and designing CFGs, Derivations Using a Grammar, Parse Trees, Ambiguity.	CO2	08



	Elimination of Ambiguity: Elimination of Left Recursion, Left Factoring. Push Down Automata: Designing PDA.		
III	Introduction to Compiler Design: Language Processors, Phases of Compilers. Lexical Analysis Phase of Compiler Design: Role of Lexical Analyzer, Input Buffering, Specification of Token, Recognition of Token.	CO3	06
IV	Syntax Analysis Phase of Compilers: Role of Parser, Top-Down Parsing, Bottom-up Parsing.	CO4	10
V	Other Phases of Compilers: Syntax Directed Translation, Syntax-Directed Definitions, Evaluation Orders for SDDs. Intermediate-Code Generation, Variants of Syntax Trees, Three-Address Code. Code Generation: Issues in the Design of a Code Generator.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to Automata Theory, Languages and Computation	John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	Pearson	3 rd	All
2	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman	Compilers Principles, Techniques and Tools	Pearson	2 nd	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.udemy.com/course/formal-languages-and-automata-theory>
2. <https://www.classcentral.com/course/edx-automata-theory-376>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	2	-	1	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24603A	Contact Hrs /week: 03
Course Description: Computer Vision		No. of Credits: 04 L:T:P:S = 3:0:2:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Machine Learning and Deep Learning		

1. PREAMBLE ABOUT THE COURSE

Computer Vision is an interdisciplinary field that deals with how computers can be made to gain high-level understanding from digital images or videos. This course is designed to bridge the gap between raw visual data and meaningful information by introducing students to the fundamental principles of image formation, processing, and analysis. Starting with the basics of digital image processing, the course transitions into complex techniques like segmentation, restoration, and object recognition. By integrating concepts from Machine Learning and Deep Learning (the course prerequisites), it prepares students to build systems that can "see" and interpret the world, which is essential for modern applications in robotics, autonomous vehicles, and medical imaging.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamentals of computer vision and digital image processing
CLO2	To introduce the processes involved image enhancement and restoration.
CLO3	To facilitate the students to gain understanding color image processing and morphology
CLO4	To impart the knowledge of image segmentation and object recognition techniques

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the fundamentals of computer vision and its applications	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Understand L2	WK2-WK4	08

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CO2	Apply the image enhancement techniques for smoothing and sharpening of images	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO3	Compare the different image restoration and segmentation techniques	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO4	Demonstrate the smoothing and sharpening techniques for color images	PO1, PO2, PO3, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO5	Explain morphological, feature extraction, and pattern classification techniques for object recognition	PO1, PO2, PO3, PO6, PO11, PSO2	Apply L3	WK2-WK4	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: What is computer vision? A brief history. Image Formation: Photometric image formation, The digital camera. Image processing: Point operators, Linear filtering.	CO1	08
II	Image processing: More neighborhood operators, Fourier transforms, Pyramids and wavelets, and Geometric transformations.	CO2	08
III	Image Restoration and Reconstruction: A model of Image degradation/restoration process restoration in the presence of noise only, periodic noise reduction by frequency domain filtering. Image Segmentation: Fundamentals, Point, Line and edge detection, thresholding (Foundation & Basic global thresholding only), Segmentation by region growing & region splitting & merging.	CO3	08
IV	Color Image Processing: Color fundamentals, color models, Pseudocolor image processing, full color image processing, color transformations, color image smoothing and sharpening, Using color in image segmentation, Noise in color images.	CO4	08


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V	Morphological Image Processing: Preliminaries, Erosion and Dilation, opening and closing, Hit-or-miss transform, some basic morphological algorithms Feature Extraction: Background, Boundary preprocessing (Boundary following & Chain codes only) image pattern Classification: Background, Patterns and classes, Pattern classification by prototype matching (Minimum distance classifier only)	CO5	08
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Computer Vision: Algorithms and Applications (Texts in Computer Science)	Richard Szeliski	Springer, 2022	2 nd Edition,	1 and 2
2	Digital Image Processing	Rafael C G, Woods R E. and Eddins S L	Pearson, 2019	4 th edition	3, 4, and 5
3	Computer Vision: A Modern Approach	David Forsyth and Jean Ponce	Pearson, 2015	2 nd Edition	-
4	Concise Computer Vision - An Introduction into Theory and Algorithms	Reinhard Klette	Springer, 2014	-	-

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://cse19-iiith.ylabs.ac.in/>.
2. https://onlinecourses.nptel.ac.in/noc21_ee78/preview
3. Introduction to Machine Vision: <https://www.youtube.com/watch?v=tY2gczybpf>
4. https://coralise.lehigh.edu/optml/files/2019/10/OptML_CV_tutorial_1_compressed.pdf

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	-	3	1	-	-	-	-	2
CO2	3	3	3	-	3	1	-	-	-	-	2
CO3	3	3	3	-	3	1	-	-	-	-	2
CO4	3	3	1	-	-	1	-	-	-	-	2
CO5	3	3	1	-	-	1	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES& PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24604B	Contact Hrs /week: 03
Course Description: Advanced Java Programming		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Object Oriented Programming using JAVA		

1. PREAMBLE ABOUT THE COURSE

This course provides a strong foundation in modern Java programming and enterprise application development. It covers advanced language features such as enumerations, autoboxing, wrapper types, and annotations for writing efficient and maintainable code. Learners explore the Java Collections Framework for effective data organization and manipulation. The course also introduces Servlets and JSP for dynamic web application development along with functional programming concepts using lambda expressions and streams. Finally, it emphasizes rapid application development using Spring Boot to build production-ready Java applications.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand modern Java language features such as enumerations, autoboxing, annotations, and wrapper types
CLO2	Examine the Java Collections Framework for efficient data organization, manipulation, and traversal
CLO3	Explore server-side Java technologies including Servlets and JSP for dynamicweb application development
CLO4	Analyze functional programming concepts in Java using lambda expressions, functional interfaces, and streams
CLO5	Apply Spring Boot for rapid development of production-ready Java applications with minimal configuration

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply advanced Java language features in application development.	PO1, PSO1	Understand L2	WK2, WK3, WK4	08
CO2	Utilize collection framework APIs for efficient data handling.	PO1, PSO1	Understand L2	WK4	8
CO3	Develop server-side applications using Servlets and JSP.	PO1, PO2, PO5, PSO1	Apply L3	WK2, WK3, WK4, WK6	8
CO4	Apply functional programming concepts using lambdas and streams.	PO3, PO4, PO5, PSO1, PSO2	Apply L3	WK4, WK6	8
CO5	Build and deploy basic Spring Boot applications leveraging auto-configuration and starter dependencies.	PO3, PO5, PO10, PSO1, PSO2	Apply L3	WK2, WK4, WK6	8

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Module – 1 Enumerations & Autoboxing: Enumeration fundamentals, Methods & values(), Using Enumerations in switch-case, Auto-boxing & Unboxing, Wrapper classes Annotations: Basics of Annotations, Marker & Single-member Annotations, Retention Policies, Built-in annotations	CO1	08
II	Module – 2 Collections Framework: Overview of Collections, Collection Interfaces: List, Set, Queue, SortedSet, Collection Classes: ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet, PriorityQueue, ArrayDeque, EnumSet, EnumMap, Using Iterators, Iterator vs. For-Each loop, Comparators	CO2	08

III	Module – 3 Servlets: Background & lifecycle, Servlet API overview, Handling HTTP Requests (GET & POST), Cookies, Sessions, Request & Response handling, Using Tomcat Java Server Pages (JSP): JSP Tags, Variables & Objects, Scriptlets, Control Structures, Sessions, Cookies, JSP/Servlet integration	CO3	08
IV	Module – 4 Lambda and Functional Programming: Lambda Expressions: First Lambda Expression, Spot a Lambda, Using Values, Functional Interfaces, Type Inference Streams: From External Iteration to Internal Iteration, What's Actually Going On, Common Stream Operations, Refactoring Legacy Code, Multiple Stream Calls, Higher-Order Functions, Good Use of Lambda Expressions	CO4	08
V	Module – 5 Spring Boot Bootstarting Spring: Spring rebooted, Getting started with Spring Boot Developing your first Spring Boot application: Putting Spring Boot to work, Using starter dependencies, Using automatic configuration	CO5	8

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Java: The Complete Reference	Herbert Schildt	McGraw-Hill	12th Edition	1, 2, 3
2	Java 8 Lambdas: Pragmatic Functional Programming	Richard Warburton	O'Reilly Media, 2014	1st Edition	4
3	Spring Boot in Action	Craig Walls	Manning Publications, 2016	1st Edition	5
4	Kathy Sierra & Bert Bates	Head First Java	O'Reilly Media, 2005	2nd Edition	1, 2, 3, 4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. JAVA the Complete Reference

<https://www.pdfdrive.com/java-the-complete-reference-ninth-edition-d195103672.html>

2. J2EE The Complete Reference

<https://vdoc.pub/download/j2ee-the-complete-reference-5j44u3vcv9v0>

<https://drive.google.com/file/d/0B420YGPB6ALfMjhlNGZlODMtMzFmYi00NGMyLTlmMzEtOTExMTRkNmUzMzM2/view?hl=en&resourcekey=0-e-h0FE-ZcFwPfbHP1Q0Ddw>

3. Spring Boot

[Full-Stack Java Dev with Spring & Spring Boot | Coursera](#)

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-
CO4	-	-	3	2	2	-	-	-	-	-	-
CO5	-	-	2	-	3	-	-	-	-	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	3	-
CO4	3	3
CO5	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24604C	Contact Hrs /week: 03
Course Description: Ad Hoc Wireless Technology		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Computer Networks		

1. PREAMBLE ABOUT THE COURSE

The course on Ad hoc Wireless Networks provides an in-depth understanding of the architecture, characteristics, and challenges of infrastructure-less wireless communication systems. It covers topics such as routing protocols, MAC mechanisms, QoS, energy management, and security in mobile ad hoc, sensor, and vehicular networks. Students will learn to analyze and design protocols for dynamic and distributed wireless environments, preparing them for research and development in modern wireless communication technologies.

2. COURSE LEVEL OBJECTIVES

CLO1	To provide the basic knowledge of fundamental principles of Ad hoc Wireless Networks.
CLO2	To gain a comprehensive understanding of ad hoc network MAC protocols
CLO3	To outline the current and emerging trends ad hoc routing protocols
CLO4	To study energy management and security techniques in ad hoc wireless network.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the principles, challenges, and characteristics of ad hoc wireless networking environments.	PO1, PO2, PSO2	Understand L2	WK1, WK2, WK3	07
CO2	Examine medium access mechanisms to support efficient and reliable communication in ad hoc wireless networks	PO1, PO2, PO3, PO5, PSO2	Apply L3	WK4, WK5, WK6	10
CO3	Analyse routing and transport mechanisms to enhance dynamic network performance	PO1, PO2, PO3, PO5, PSO2	Apply L3	WK4, WK5, WK6	15
CO4	Assess energy and security aspects to improve robustness in ad hoc wireless networks.	PO1, PO2, PSO2	Apply L3	WK4, WK5, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Ad hoc networks: Introduction, Issues in Ad hoc wireless networks, Ad hoc wireless internet. MAC protocols for ad hoc wireless networks: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks	CO1, CO2	08
II	Classification of MAC protocols: Taxonomy, Contention-based MAC protocols with a scheduling mechanism, MAC protocols that use directional antennas, and Other MAC protocols	CO2	08

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III	Routing protocols for ad hoc wireless networks-1: Introduction, Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Table drive routing protocol, On-demand routing protocol.	CO3	08
IV	Routing protocols for ad hoc wireless networks-2: Hybrid routing protocol, Routing protocols with effective flooding mechanisms, Hierarchical routing protocols, Power aware routing protocol	CO3	08
V	Transport layer protocols for ad hoc wireless networks: Introduction, Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks. Security: Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning	CO3, CO4	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Ad hoc Wireless Networks	C. Siva Ram Murthy, B.S., Manoj	Pearson Education	3 rd	All
2	Ad hoc wireless Networks	Ozan K.Tonguz, Gianguigi Ferrari	Wiley	-	All
3	Ad hoc wireless Networking"	Xiuzhen Cheng, Xiao Hung, Ding- Zhu Du	Kluwer Academic publishers.	1 st	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://nptel/courses/video/106105160/L01.html>
2. <https://www.cisco.com/c/en/us/solutions/artificial-intelligence/artificialintelligence-machine-learning-in-networking.html>

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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	1	-	-	-	-	-	-
CO3	3	3	3	-	1	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24604D	Contact Hrs /week: 03
Course Description: Enterprise Architecture		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Software Engineering, Computer Networks		

1. PREAMBLE ABOUT THE COURSE

This course introduces students to the frameworks, methodologies, and tools for designing and managing the architecture of complex enterprise systems. It covers key principles of aligning business processes, information systems, and technology infrastructure with organizational strategy. Students will gain practical knowledge of EA frameworks such as TOGAF, Zachman, and FEAF, and learn how to document, analyze, and optimize enterprise systems to improve agility, interoperability, and business value.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts, principles, and frameworks of enterprise architecture.
CLO2	Analyze and model enterprise business processes, data, applications, and technology infrastructure.
CLO3	Apply EA frameworks (TOGAF, Zachman, FEAF) for strategic planning and decision-making.
CLO4	Evaluate the role of governance, standards, and best practices in enterprise architecture.
CLO5	Develop practical skills in documenting, assessing, and optimizing enterprise systems

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Describe the principles, components, and benefits of Enterprise Architecture in organizational strategy.	PO1, PO2, PO4, PO9, PO11, PSO1, PSO2	Understand L2	WK1, WK2	08
CO2	Articulate EA frameworks to model business, data, application, and technology layers.	PO1, PO2, PO4, PO5, PO9, PO11, PSO1, PSO2	Apply L3	WK2, WK3, WK4	08
CO3	Interpret business processes and technology systems to identify gaps and improvement opportunities	PO1, PO2, PO4, PO5, PO9, PO11, PSO1, PSO2	Apply L3	WK3, WK4, WK6	08
CO4	Design enterprise architecture models to support effective decision-making.	PO1, PO2, PO4, PO5, PO9, PO11, PSO1, PSO2	Apply L3	WK3, WK4, WK5	08
CO5	Identify EA governance standards and best practices for sustainable, scalable architecture.	PO1, PO2, PO4, PO5, PO9, PO11, PSO1, PSO2	Apply L3	WK4, WK5, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Enterprise Architecture: Definition, objectives, and benefits of EA, EA and organizational strategy, EA components: business, application, data, and technology layers.	CO1	08
II	EA Frameworks: TOGAF (The Open Group Architecture Framework), ADM (Architecture Development Method), Architecture views and deliverables, Zachman Framework, Federal Enterprise Architecture Framework (FEAF).	CO2	08
III	Business Architecture: Business process modelling, Value chains, capabilities, and organizational structure, Business requirements analysis Information and Application Architecture: Data architecture: modeling, standards, data governance, Application architecture: portfolio management, integration, interoperability, SOA (Service-Oriented Architecture) overview.	CO3	08

IV	Technology Architecture: Infrastructure architecture, Cloud computing and EA, Emerging technologies and EA implications	CO4	08
V	EA Governance and Implementation: Governance, compliance, and standards, EA documentation and tool support, Case studies and best practices in EA adoption	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Enterprise Architecture As Strategy: Creating a Foundation for Business Execution	Jeanne W. Ross, Peter Weill, David Robertson	Harvard Business School Press	1 st	All
2	TOGAF 9 Certified Study Guide – 4th Edition	Rachel Harrison	Van Haren Publishing	4 th	All
3	Enterprise Architecture at Work: Modelling, Communication and Analysis	Marc Lankhorst et al.	Springer	4 th	All
4	The Zachman Framework for Enterprise Architecture: A Primer for Enterprise Engineering and Manufacturing	John A. Zachman	Zachman Institute	-	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.coursera.org/learn/enterprise-architecture-fundamentals>
2. <https://www.udemy.com/course/togaf-9-training-course/>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	2	-	2	-	-	-	-	2	-	2
CO2	3	3	-	2	2	-	-	-	2	-	2
CO3	3	3	-	2	2	-	-	-	2	-	2
CO4	3	3	-	2	2	-	-	-	2	-	2
CO5	3	3	-	2	2	-	-	-	2	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24605A	Contact Hrs /week: 03
Course Description: MongoDB for Developers		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: DBMS		

1. PREAMBLE ABOUT THE COURSE

This course provides a comprehensive introduction to MongoDB, a popular NoSQL database known for ease of use and scalability. Students will learn core concepts like documents, collections, databases, and work with the MongoDB shell and data types. It covers CRUD operations and advanced querying techniques to efficiently manage data. Students will explore indexing strategies to optimize performance and understand sharding for scaling clusters. By the end, learners will be equipped to build scalable, high-performance applications using MongoDB.

2. COURSE LEVEL OBJECTIVES

CLO1	Explain MongoDB's core concepts, architecture, scalability, and key components like documents, collections, and databases.
CLO2	Demonstrate CRUD operations in MongoDB shell and understand supported data types.
CLO3	Develop skills to write advanced queries, utilize indexes for optimizing query performance, and administer index management effectively.
CLO4	Understand and manage MongoDB sharding, including balancer, collations, and change streams for scalable data distribution.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Illustrate MongoDB's core philosophy, scalability, and perform basic operations with documents, collections, and the shell.	PO1, PO5, PSO1	Understand L2	WK1,WK4, WK6	08
CO2	Apply shell commands to create, update, and delete MongoDB documents effectively.	PO1, PO5, PSO1	Apply L3	WK1,WK4, WK6	08
CO3	Apply and construct queries using find, criteria, type-specific, and \$where queries, and manage results with cursors.	PO1, PO2, PO5, PO7, P08, PO9, PSO1	Apply L3	WK1,WK4, WK6	09
CO4	Demonstrate MongoDB index types, interpret explain output, and manage index creation and administration.	PO1, PO2, PO5, PO7, P08, PO9, PSO1	Apply L3	WK1,WK4, WK6	09
CO5	Apply and configure MongoDB sharding, and manage key components such as the balancer, collations, and change streams.	PO1, PO5, PSO1	Apply L3	WK1,WK4, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Ease of Use, Designed to Scale, Rich with Features, Without Sacrificing Speed, The Philosophy Getting Started : Documents, Collections, Databases, Getting and Starting MongoDB, Introduction to the MongoDB Shell, Data Types, Using the MongoDB shell	CO1	08
II	Creating, Updating, and Deleting Documents: Inserting Documents, Removing Documents, Updating Documents	CO2	08

III	Querying : Introduction to find, Query Criteria, Type – Specific Queries, \$where Queries, Cursors	CO3	08
IV	Indexes : Introduction to Indexes, explain Output, When Not to Index, Types of Indexes, Index Administration.	CO4	08
V	Introduction to Sharding : What is Sharding, Sharding on a Single-Machine Cluster Configuring Sharding : When to Shard, Starting the Servers, How MongoDB Tracks Cluster Data, The balancer, Collations, Change Streams	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	MongoDB: The Definitive Guide	Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow,	O'Reilly Media	3rd Edition.	1,2,3,4,5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://www.mongodb.com/docs/>
2. <https://www.geeksforgeeks.org/mongodb/mongodb-tutorial/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	2	-	-	-	-	-	-
CO2	2	-	-	-	2	-	-	-	-	-	-
CO3	2	2	-	-	2	-	1	1	1	-	-
CO4	2	2	-	-	2	-	1	1	1	-	-
CO5	2	-	-	-	2	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24605B	Contact Hrs /week: 03
Course Description: Data Visualization using Python		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Python		

1. PREAMBLE ABOUT THE COURSE

In the era of big data, the ability to extract meaningful insights from vast volumes of information is more valuable than ever. However, raw data alone rarely tells a clear story. To uncover patterns, identify trends, and communicate findings effectively, data must be visualized.

Data Visualization using Python is a guide to transforming complex data into intuitive visual representations. This resource introduces the foundational principles of data visualization while leveraging the power and flexibility of Python's extensive libraries—such as Matplotlib, Seaborn, Plotly, and Pandas—to create compelling and informative graphics.

Whether you are a student, data analyst, researcher, or professional, this guide aims to equip you with practical skills to:

- Explore and understand datasets visually,
- Choose the right type of chart for your data and audience,
- Use Python tools to build clear and impactful visualizations, and

Through hands-on examples and best practices, this material bridges the gap between data analysis and effective communication, enabling users to turn data into decisions.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the concepts of Numpy and Pandas for data wrangling
CLO2	Understand the basic and advanced statistics for data science
CLO3	Implement Visualization techniques using Python programming

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Describe the basic concepts and importance of data visualization and the principles of good chart design.	PO1	Understand L2	WK2, WK6	06
CO2	Use Python libraries like NumPy, Pandas, and Matplotlib to read and write data.	PO1, PO5, PO11	Apply L3	WK2, WK6	10
CO3	Perform array operations such as slicing, indexing, and transposing using NumPy.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08
CO4	Apply Pandas Series and DataFrame operations to analyze and manipulate datasets.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08
CO5	Use Matplotlib and Pandas to generate and customize different types of plots to visually represent a given dataset.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Data Visualization fundamentals: Introduction to Data Visualization, Importance of Data Visualization, Data Visualization Tools, Four Pillars of Visualization, Principles of Chart design.	CO1	06
II	Python libraries: Motivation for using Python for Data Visualization, Essential Python Libraries, NumPy, Pandas, Matplotlib, Import and Export of Data, Import and Export of data using files.	CO2	10
III	Array manipulation using Numpy: Creating Numpy arrays, Data Types for Numpy arrays, Arithmetic with NumPy	CO3	08

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	Arrays Basic Indexing and Slicing, swapping axes, transposing arrays.		
IV	Data Manipulation using Pandas: Data Structures in Pandas: Series, DataFrame, Index objects, Loading data into Pandas data frame. Working with Data frames. Grouped and aggregate calculations	CO4	08
V	Plotting and Visualization: Using matplotlib to plot data: figures, subplots, markings, color and line styles, labels and legends, Plotting functions in Pandas: Line, bar, Scatter plots, histograms, stacked bars, boxplot.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython	McKinney W	O'Reilly Media	2 nd	All
2	Pandas for Everyone: Python Data Analysis	Chen D. Y	Pearson	-	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.perlego.com/book/3815910/data-visualization-exploring-and-explaining-with-datapdf>
2. <https://www.coursera.org/specializations/data-analysis-visualization-foundation>
3. <https://www.coursera.org/learn/datavisualization>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	1	-	-	-	-	-	2
CO3	2	3	2	-	1	-	-	-	-	-	2
CO4	2	3	3	-	1	-	-	-	-	-	2
CO5	2	3	3	-	1	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	2	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24605C	Contact Hrs /week: 03
Course Description: Cloud Computing		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Networking and Internet Protocols, Operating Systems and Virtualization		

1. PREAMBLE ABOUT THE COURSE

Cloud computing represents a transformative approach to delivering computing resources, enabling on-demand access to shared pools of configurable services such as servers, storage, networks, applications, and data. Rather than relying on traditional on-premises infrastructure, organizations and individuals can leverage cloud platforms to scale resources dynamically, reduce operational costs, and improve efficiency. This paradigm supports flexibility, rapid deployment, and global accessibility, making it a cornerstone of modern digital transformation. By abstracting the complexity of hardware management and maintenance, cloud computing allows users to focus on innovation and core business objectives. Its service models—Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS)—cater to varying levels of control and customization. As technologies such as big data analytics, artificial intelligence, and the Internet of Things continue to evolve, cloud computing plays a critical role in enabling secure, scalable, and resilient systems across industries.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the core concepts of the Cloud Computing paradigm and its reference models
CLO2	Illustrate how System Virtualization is used in Cloud Computing system models.
CLO3	Apply cloud management tools and security principles to build secure and well-administered cloud environments
CLO4	Use industry cloud platforms (AWS, Azure, GCP) to develop and deploy cloud-based applications

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Define the concepts and basic terminologies of Cloud Computing	PO1, PO2, PO11, PSO1, PSO2	Understand L2	WK1, WK2, WK6	08
CO2	Classify the concepts of Virtualization in Cloud Computing	PO1, PO2, PO3, PO5, PO11, PSO1, PSO2	Understand L2	WK1, WK2, WK3, WK4, WK5	08
CO3	Describe the Reference Models for Cloud Computing	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Understand L2	WK1, WK2, WK3, WK4, WK5	08
CO4	Apply cloud management tools and security principles to demonstrate secure data handling and identity establishment in a cloud environment.	PO1, PO2, PO3, PO4, PO5, PO8, PSO1, PSO2	Apply L3	WK3, WK4, WK5, WK6, WK8	08
CO5	Use AWS, Azure, or Google Cloud to develop and deploy a functional cloud application for a scientific or business domain.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PSO1, PSO2	Apply L3	WK3, WK4, WK5, WK6, WK8, WK9	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: Defining Cloud Computing, Cloud Types, Examining the Characteristics of Cloud Computing Historical Developments, Building Cloud Computing Environments Computing Platform and Technologies.	CO1	08


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	Principles of Parallel and Distributed Computing: Eras of Computing, Parallel vs Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing.		
II	Virtualization: Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization, Para Virtualization and Full Virtualization, Technology Examples: VMware Microservices, Dockers and Containers: An introduction to Microservices, Modular Architecture, Advantages and Disadvantages of Microservices. Dockers Containers, Dockers architecture and Components, The Power of Docker: A Simple Example.	CO2	08
III	Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges.	CO3	08
IV	Managing the Cloud: Adminstrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards Understanding Cloud Security: Securing the Cloud, Securing Data, Establishing Identity and Presence.	CO4	08
V	Cloud Platforms in Industry: Amazon Web Services, Google AppEngine, Microsoft Azure Cloud Applications - Scientific Applications, Business and Consumer Applications.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Mastering Cloud Computing	Rajkumar Buyya, Christian Vecchiola, S Thamarai	Tata McGraw Hill Education Private Limited	2013	1,3,5
2	Microservices and Containers	Parminder Singh Kocher	Addison Wesley	2018	2
3	Cloud Computing Bible	Barrie Sosinsky	Wiley Publishing, Inc	2011	4



6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://docs.aws.amazon.com/?nc2=h_ql_doc_do
2. <https://aws.amazon.com/getting-started/hands-on/>
3. https://learn.microsoft.com/en-us/training/browse/?products=azure&resource_type=learning%20path

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	1	-	-	-	-	-	-	-	-	2
CO2	3	2	1	-	2	-	-	-	-	-	1
CO3	3	2	2	1	1	-	-	-	-	-	1
CO4	2	3	3	1	3	-	-	2	-	-	-
CO5	2	2	3	1	3	2	-	2	2	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	1	2
CO2	2	2
CO3	2	3
CO4	3	2
CO5	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24605D	Contact Hrs /week: 03
Course Description: Full Stack Framework – Frontend Tools		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basic Programming		

1. PREAMBLE ABOUT THE COURSE

The front end of a full-stack application is the layer where users interact with software: it translates data and business logic into intuitive interfaces, responsive layouts, and accessible experiences. Modern front-end tooling has evolved into a rich ecosystem of frameworks, libraries, build tools, design systems, and testing suites that together speed development, improve performance, and raise the quality and maintainability of web applications.

This module introduces the core front-end concepts and practical tools used in contemporary full-stack development. Students will learn component-based UI frameworks, state management patterns, styling systems, bundlers and dev servers, and front-end testing and debugging workflows. Emphasis is placed on choosing appropriate tools for project requirements (performance, team scale, accessibility, progressive enhancement) and integrating front-end stacks smoothly with back-end APIs and deployment pipelines.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts of front-end development and the role of client-side technologies in full-stack frameworks.
CLO2	Explore modern front-end frameworks and libraries (such as React, Angular, or Vue) to design responsive, component-based user interfaces.
CLO3	Apply HTML5, CSS, and JavaScript (ES6+) features to develop dynamic and interactive web applications.
CLO4	Utilize front-end build tools, package managers, and workflow automation systems (such as npm, Webpack, Vite) to optimize development and deployment processes.
CLO5	Implement effective state management, routing, and API integration in front-end applications for seamless interaction with back-end services.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the fundamental principles, architecture, and role of front-end tools in full-stack frameworks.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L2	WK4, WK6	08
CO2	Design and develop responsive, user-friendly interfaces using HTML, CSS, and JavaScript.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L3	WK5, WK6	08
CO3	Build modular, component-based applications using modern front-end frameworks such as React, Angular, or Vue.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L3	WK4, WK6	08
CO4	Implement state management, routing, and API communication for dynamic data-driven web applications.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L3	WK4, WK6	08
CO5	Use build tools, version control, and package managers to streamline development and deployment processes.	PO1, PO2, PO3, PO4, PO5, PO9, PO11, PSO1, PSO2	L3	WK4, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Front-End Development: Overview of Full-Stack Architecture: Front-End, Back-End, Database, Role and Responsibilities of Front-End in a Full-Stack Application, Basics of Web Technologies: HTML5, CSS, JavaScript (ES6+), DOM Manipulation and Event Handling, Introduction to Responsive Design and UX Principles.	CO1, CO2	08

II	Advanced JavaScript and Modern Front-End Concepts: JavaScript ES6+ Features (let, const, arrow functions, promises, async/await), Modular JavaScript and Component-Based Architecture, Introduction to TypeScript and Static Typing, JSON and API Communication Basics, Error Handling and Debugging Techniques.	CO3	08
III	Front-End Frameworks (React / Angular / Vue): Framework Architecture and Setup (Choose one: React, Angular, or Vue), Components, Props, and State, Conditional Rendering and Lists, Forms and Validation, Routing and Navigation, Component Lifecycle and Hooks (React) / Directives (Angular)	CO4	08
IV	Styling, Build Tools, and Workflow Automation: CSS Frameworks: Bootstrap, Tailwind CSS, Material UI, CSS-in-JS, SCSS, and Styled Components, Build Tools: Webpack, Vite, Parcel, Package Managers: npm, Yarn, pnpm, Code Quality and Formatting Tools: ESLint, Prettier, Version Control using Git and GitHub	CO5	08
V	Testing, Optimization, and Deployment: Testing Frameworks: Jest, React Testing Library, Cypress, Debugging Tools: Browser DevTools, React Developer Tools, Performance Optimization: Code Splitting, Lazy Loading, Caching, Accessibility and SEO Basics, Deployment: Netlify, Vercel, GitHub Pages, or Firebase Hosting, Integrating Front-End with Back-End APIs	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Learning React	Alex Banks & Eve Porcello	O'Reilly	1 st Edition	1, 2, 3
2	Pro Angular	Adam Freeman	Apress.	3rd Edition.	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.freecodecamp.org/learn/responsive-web-design>
2. HTML Crash Course — <https://youtu.be/UB1O30fR-EE>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	2	-	-	-	1	-	3
CO2	3	2	3	2	2	-	-	-	2	-	3
CO3	3	2	2	2	3	-	-	-	2	-	3
CO4	2	3	2	2	3	-	-	-	2	-	3
CO5	2	2	2	3	3	-	-	-	1	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCSL24607	Contact Hrs /week: 02
Course Description: Mobile App Development using Flutter		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: PCCL		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Any Programming Language		

1. PREAMBLE ABOUT THE COURSE

This lab provides hands-on experience in designing and developing mobile applications using **Flutter**. Students will learn to create structured **UI layouts**, implement **interactive widgets**, handle **forms and validation**, add **animations and media features**, and integrate **backend services** like **Firestore**. These exercises build skills to design, implement, and deploy functional mobile applications.

2. COURSE LEVEL OBJECTIVES

CLO1	Design and implement structured mobile interfaces using Flutter widgets, layouts, and state management techniques.
CLO2	Develop interactive and responsive applications , including forms with validation, user input handling, and dynamic UI updates.
CLO3	Integrate advanced features and backend services , such as animations, media handling, navigation, and Firestore CRUD operations, to build functional mobile applications.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
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CO1	Apply Flutter layout widgets, UI elements, and state management techniques to build structured mobile interfaces and interactive applications.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK1, WK2, WK3, WK4	06
CO2	Implement responsive, validated, and interactive form-based mobile applications using Flutter frameworks.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK5, WK6	10
CO3	Develop advanced mobile app features such as animations, media handling, navigation, and backend integration using Flutter and Firebase.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK5, WK6	12

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	Design a mobile app using Flutter that displays a screen with the following layout: - A centered heading at the top - Two buttons placed side-by-side in a horizontal row - A footer text positioned at the bottom of the screen Use Column, Row, and MainAxisAlignment effectively to structure the layout.	CO1	02
2	Design a Flutter mobile app that displays three colorful containers arranged vertically. Each container should demonstrate the use of padding, margin, border radius, and shadow effects . Ensure proper layout using Flutter widgets such as Column and Container.	CO1	02
3	Design a Flutter mobile app that displays a personal profile card. The card should include: - A circular profile image - Name, email, and phone number Use Flutter widgets such as Card, ListTile, CircleAvatar, and Icon to create the layout.	CO1	02

4	Design a mobile app in Flutter that displays a static login screen. The screen should include: • A TextField for entering email (with an email icon) • A TextField for entering password (with a password icon) • An ElevatedButton for login Implement basic validation: • Email field should not be empty • Password should be at least 6 characters Use proper Flutter widgets, layout, and styling to create a visually appealing login interface.	CO2	04
5	Design a Flutter mobile application that displays a counter on the screen. Implement three buttons Increment, Decrement and Reset to modify the counter value. Use setState() to update the UI whenever the counter changes. Ensure the app is visually organized and user-friendly.	CO2	02
6	Design a Flutter mobile application that contains a form with the following fields: • Name • Email • Phone Implement proper validation for each field, and display a success message when the user submits the form successfully.	CO2	04
7	Design a Flutter mobile app that displays a box which animates its size and color whenever a button is pressed, using AnimatedContainer.	CO3	02
8	Design a Flutter mobile application that includes a Lottie animation as a splash screen: • Display a Lottie animation (e.g., a loading animation) when the app starts. • Automatically navigate to the Home Screen after 3 seconds. • Use proper Flutter widgets and navigation techniques to implement the functionality.	CO3	04
9	Design a Flutter mobile application that allows the user to • Select an image from the device gallery using the image_picker package • Display the selected image on the screen	CO3	02
10	Create a mobile application using Flutter that allows users to manage student records. The app should include the following features:	CO3	04

	• Add new student information, including name and age. • Store all student records in Firestore. • Provide functionality to read, update, and delete student records. • Display all student records in a ListView with proper UI design. Use appropriate Flutter widgets, state management, and Firestore integration to implement this app.		
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Beginning Flutter: A Hands-On Guide to App Development	Marco L. Napoli	Wiley	1st Edition	Flutter basics, UI widgets, layouts, state management, navigation
2	Flutter for Beginners	Alessandro Biessek	Packt Publishing	2nd Edition	Dart basics, layouts, forms, validation, ListView, state management
3	Flutter Cookbook	Simone Alessandria, Brian Kayfitz	O'Reilly Media	1st Edition	Animations, media handling, packages, responsive UI, best practices
4	Programming Flutter: Native, Cross-Platform Apps the Easy Way	Carmine Zaccagnino	Pragmatic Bookshelf	1st Edition	Advanced UI, backend integration, Firebase, app architecture

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.freecodecamp.org/news/flutter-cross-platform-app-development-tutorial/>
2. <https://www.coursera.org/learn/flutter-and-dart-developing-ios-android-mobile-apps>
3. <https://www.mygreatlearning.com/academy/learn-for-free/courses/flutter-for-beginners>



7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	3	-	3	-	-	-	-	-	1
CO2	1	2	3	-	3	-	-	-	-	-	1
CO3	1	1	3	-	3	-	-	-	-	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24657A	Contact Hrs /week: 02
Course Description: Prototyping Internet of Smart Devices		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category: AEC/SDC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of any programming, Applications of Sensors		

1. PREAMBLE ABOUT THE COURSE

The Internet of Things (IOT) has emerged as a transformative force. This leads to rapid advancements in sensor technology, pervasive connectivity (5G, Wi-Fi), and sophisticated data analytics, has revolutionized industries from manufacturing to healthcare and smart cities.

This course explores the fundamental ideas of the Internet of Things, including data processing, cloud integration, communication protocols, device architecture, and strong security mechanisms. To comprehend how embedded systems interact with the digital world, learners will investigate practical examples. Students will improve their chances of becoming highly sought-after experts who can design, create, and manage the intelligent systems that shape our future by becoming proficient in these many areas. They are prepared to innovate and prosper in the rapidly growing IOT ecosystem thanks to this training.

2. COURSE LEVEL OBJECTIVES

CLO1	To learn fundamental of IoT and its model .
CLO2	To gain knowledge and expertise in Actuation and Sensor functions
CLO3	To visualize data through cloud platforms
CLO4	Develop small-scale applications using simulation tools and Hardware controllers.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the fundamentals of IoT architecture and identify components involved in smart device prototyping.	PO1, PO2, PO5, PSO1	Understand L2	WK1	04
CO2	Demonstrate sensor and actuator interfacing techniques using microcontrollers such as ESP32 for IoT applications.	PO1, PO2, PO5, PSO1	Apply L3	WK1,2	06
CO3	Implement connectivity and data transmission using Wi-Fi/Bluetooth communication protocols and cloud platforms for IoT data visualization.	PO1, PO2, PO3, PO5, PSO1	Apply L3	WK1,2	12
CO4	Design a small-scale IoT prototype using simulation tools and hardware controllers to solve simple real-time problems	PO1, PO2, PO3, PO5, PO9, PO11, PSO1	Apply L3	WK1,2	06

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Topics: Introduction to IoT, IoT Reference model, Perception layer: basic actuation function for prototyping Introduction to ESP32, GPIO pins, digital output, LED interfacing Lab Program: i. Design an interface circuit and develop a C program to perform Actuators control (LEDs) Using loop Function. a) Develop a C program to display character, integer, float, string on Serial Monitor using UART	CO1, CO2	04
II	Topics: Perception Layer: Sensors and its characteristics, basic sensing function for prototyping Introduction to ESP32 digital Input configuration/ADC, Digital Input & Push Buttons:	CO1, CO2	06

	Lab Program: i. Develop a C program to Read a Value 0 and 1 using push button connected to D0 pin. Print a value on Serial Monitor ii. a) Develop a C program to read intensity of Light and display On Serial Monitor. b) Develop a C program to control the LED intensity using LDR		
III	Topics: Internet Communication protocols: Wi-Fi, Bluetooth and ZigBee Lab Program: i. Develop a Python program using ESP32 Bluetooth device to perform the following actions: Bluetooth device is received (either '0', '1', '2', or '3'), it performs the appropriate action (turning the LED and/or buzzer on or off). a) ii. Develop a Python program using ESP32 WIFI device to perform the following action. WIFI device is received (either '0', '1'), it performs the appropriate action (turning the LED on or off).	CO3	06
IV	Topics: IoT Associated Technology: Cloud computing. Lab Program: i. Develop a Python program on ESP32 to upload temperature and humidity data to thingspeak cloud. ii. Develop a Python program on Raspberry pi to measure the distance using ultrasonic sensor and upload the data to thingspeak cloud.	CO3	06
V	Topics: Case study on solving real time projects on IoT using Arduino/Tinker CAD All the programs can be executed in any high level language such as C and Python	CO4	06

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Internet of Things, Cengage Learning India, 017.	Srinivasa K G, Siddesh G. M, Hanumantha Raju R	Cengage	1 st Edition, 2017	All
2	IoT Fundamentals: Networking	David Hanes, Gonzalo Salgueiro,	Pearson Education	1 st Edition	Module 1 and 3

	Technologies, Protocols, and Use Cases for the Internet of Things	Patrick Grossetete, Robert Barton, Jerome Henry	(Cisco Press Indian Reprint)		
3	Internet of Things - A Hands on Approach	Vijay Madiseti and Arshdeep Bahga	Orient Blackswan Private Limited	1 st Edition, 2015	Module 1,2,5
4	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill Education	1 st Edition, 2017.	Module 1 and 2

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. <https://matlabacademy.mathworks.com/details/app-building-onramp/orab>
3. <https://docs.arduino.cc/learn/>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	3	-	-	3	-	-	-	-	-	-
CO2	3	3	-	-	3	-	-	-	-	-	-
CO3	3	3	2	-	3	-	-	-	-	-	-
CO4	3	3	2	-	3	-	-	-	2	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24657B	Contact Hrs /week: 02
Course Description: Project Management with Jira		No. of Credits: L : T : P : S = 0:0:2:0
Course Category: AEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

This course is designed to equip students with practical knowledge and hands-on experience in using Jira to manage real-world projects. It introduces key project management principles, agile methodologies such as Scrum and Kanban, and the configuration and use of Jira software to support these frameworks. By the end of the course, learners will be able to create and manage projects, configure workflows, manage backlogs, and generate reports, gaining valuable skills for careers in software development, product management, and IT project coordination.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamental concepts of JIRA and its role in project management.
CLO2	To explore the structure and types of work items used in Agile methodologies within JIRA
CLO3	To enable students to manage sprints and generate relevant reports to track progress.
CLO4	To teach students how to filter, search, and manage tasks efficiently using JQL.
CLO5	To build capability in creating interactive dashboards for effective project monitoring

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand the purpose and structure of JIRA for managing software projects.	PO1, PO5, PO6, PSO1	Understand L2	WK2	03
CO2	Create and manage work items such as epics, stories, bugs, and tasks in JIRA.	PO2, PO5, PSO1, PSO2	Apply L3	WK3	03
CO3	Apply Agile practices including Scrum and Sprint execution using JIRA.	PO2, PO3, PO5, PSO1, PSO2	Apply L3	WK3, WK4	03
CO4	Use JIRA Query Language (JQL) and reports to track project progress and performance.	PO4, PO5, PSO1	Apply L3	WK4, WK5	02
CO5	Design interactive dashboards and share project insights using gadgets and widgets.	PO5, PSO2	Apply L3	WK6	03

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to JIRA: What is JIRA? How JIRA uses projects as a way to keep work organized. Creating an account with Atlassian. Project creation and management Workflows. How to set up a project using scheme, screens, workflows, and permissions Screens, Workflows, Permissions, Notifications	CO1, CO2	03
II	Managing Work Items: Introduction to epics, stories, bugs, and tasks Creating epics, stories, bugs, and tasks, Issue type attributes and adding and removing the, Managing items in the backlog, Creating and configuring our board.	CO2, CO3	03
III	Running Your Project in JIRA: Creating and Starting a Sprint, The daily Scrum, Smaller stories or tasks, Closing the Sprint- the Sprint report.	CO3, CO4	03



	Working with Reports: Burndown report, Sprint report, Velocity chart, Release and epic burndowns, Version and epic reports		
IV	Searching and Filtering on Issues Issue searching using JQL: Simple and advanced JQL editors in JIRA, Saving and managing filters, Executing bulk changes, Creating new boards from saved filters.	CO4	02
V	Dashboards and Widgets: Creating and managing a dashboard Adding gadgets to our dashboard Sharing the dashboard	CO4, CO5	03

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Hands-On Agile Software Development with JIRA	David Harned	Packt Publishing Ltd.	First Edition, 2018	I, II, III, V
2	Atlassian Jira Service Desk A Complete Guide	Gerardus Blokdyk	Atlassian	2020	IV

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

- <https://www.youtube.com/user/GoAtlassian>
- <https://www.youtube.com/watch?v=rFIyK8aDsGc>
- <https://www.youtube.com/watch?v=zgYiDbl6HN4>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	2	1	-	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-
CO3	-	3	2	-	3	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	2
CO3	1	2
CO4	3	-
CO5	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24657C	Contact Hrs /week: 02
Course Description: Software Development Approach with DevOps		No. of Credits: 1 L : T : P : S = 0:0:2:0
Course Category: AEC		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Unix Shell programming		

1. PREAMBLE ABOUT THE COURSE

In an era where digital agility determines business success, the traditional, siloed approach to software development and IT operations is no longer sustainable. **DevOps**—a compound of "Development" and "Operations"—is not merely a set of tools, but a foundational shift in culture, philosophy, and practices designed to bridge this gap. This course introduces the methodologies required to enhance collaboration, increase deployment velocity, and improve the reliability and security of software systems.

2. COURSE LEVEL OBJECTIVES

CLO1	To familiar with basic command of Git
CLO2	To create and manage branches
CLO3	To understand how to collaborate and work with Remote Repositories
CLO4	To familiar with version controlling commands

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply basic Git commands to initialize, configure, and manage local repositories.	PO1, PO2, PO3, PO4, PO5, PO8, PO9, PO11, PSO2	Apply L3	WK3, WK4, WK5, WK6	05
CO2	Implement branching strategies by creating, switching, merging, and	PO1, PO2, PO3, PO4, PO5, PO8,	Apply L3	WK3, WK4,	04

	deleting branches within a Git repository.	PO9, PO11, PSO2		WK5, WK6	
CO3	Execute Git commands for remote collaboration, including cloning, pushing, pulling, and managing remotes.	PO1, PO2, PO3, PO4, PO5, PO8, PO9, PO11, PSO2	Apply L3	WK3, WK4, WK5, WK6	05
CO4	Use Git commands to create and manage tags and releases, and apply advanced Git operations such as stashing, rebasing, and cherry-picking.	PO1, PO2, PO3, PO4, PO5, PO8, PO9, PO11, PSO2	Apply L3	WK3, WK4, WK5, WK6	05
CO5	Integrate Continuous Integration (CI), Continuous Testing (CT), and Continuous Deployment (CD) practices using Jenkins	PO1, PO2, PO3, PO4, PO5, PO8, PO9, PO11, PSO2	Apply L3	WK3, WK4, WK5, WK6	05

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Program No.	Program Description	Mapped COs	No. of Hours
1	a. Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message. b. Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master."	CO1, CO2	03
2	a. Write the commands to stash your changes, switch branches, and then apply the stashed changes. b. Clone a remote Git repository to your local machine.	CO1, CO3	03
3	a. Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch. b. Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge.	CO1, CO2	03

4	a. Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository. b. Write the command to cherry-pick a range of commits from "source-branch" to the current branch.	CO4	01
5	a. Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message? b. Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31."	CO2, CO3	02
6	a. Write the command to display the last five commits in the repository's history also undo the changes introduced by the commit with the ID "abc123". b. Write the command to Define custom Git aliases for common commands like git st for git status, git lg for git log.	CO1, CO2	02
7	a. Simulate reverting entire merge commit using git revert -m. b. Accidentally delete a branch or reset a commit, then use git reflog to recover the lost commit.	CO4	03
8	a. Add several untracked files to the repo and then use git clean to remove them safely. b. Create a .zip or .tar archive of a specific branch or commit using git archive.	CO3, CO4	02
9	Installing Jenkins on Jenkins Install on Linux, Configuring Jenkins for First Use	CO5	02
10	Configure a Jenkins Freestyle project to integrate with a GitHub repository using Source Code Management (SCM), and build based on changes in the Git repository.	CO5	03

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The DevOps Handbook	Gene Kim, Patrick Debois, John Willis, Jez Humble	IT Revolution Press	2nd Ed	DevOps culture & principles; CI/CD workflows; Lean practices; Metrics, automation strategies

2	GitHub Cookbook	Stephen H. Nelson	Packt Publishing	1st Ed	Practical <i>recipes</i> for GitHub workflows; CI (GitHub Actions); Project automation and collaboration
3	Jenkins Essentials	Mitesh Soni	Packt Publishing	1st Ed	Jenkins fundamentals; Set up & configure jobs; Basic CI/CD workflows

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. Git Tutorial : <https://www.geeksforgeeks.org/git/git-tutorial/>
2. **GitHub Actions CI/CD (GitHub blog)** – <https://github.blog/enterprise-software/ci-cd/build-ci-cd-pipeline-github-actions-four-steps/>
3. **Git & GitHub Crash Course (YouTube)** – fundamentals + workflow
<https://www.youtube.com/watch?v=vA5TTz6BXhY>
4. **Jenkins Tutorials (Official)** – step-by-step beginner guides
<https://www.jenkins.io/doc/tutorials/>
5. **Introduction to DevOps (Great Learning)** – Git, Docker, Jenkins basics
<https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-devops1>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	2	1	1	3	-	-	1	2	-	1
CO2	3	2	1	1	3	-	-	1	2	-	1
CO3	3	2	1	1	3	-	-	1	2	-	1
CO4	3	2	1	1	3	-	-	1	2	-	1
CO5	3	3	3	1	3	-	-	1	2	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



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Department: Computer Science and Engineering		
Semester: VI	Course Code: BCS24657D	Contact Hrs /week: 2
Course Description: Selenium Automation Testing		No. of Credits: 01 L : T : P : S = 0:0:2:0
Course Category:		Total no. of Hours = 28
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Software Engineering		

1. PREAMBLE ABOUT THE COURSE

Selenium is a leading open-source framework designed for automating web applications across multiple browsers and platforms. Its cross-language support and flexibility make it a vital tool in modern software testing practices. This course provides a structured understanding of Selenium's architecture, features, and implementation techniques, with emphasis on test design, execution, and integration into continuous development environments. Learners will gain the skills required to develop and maintain efficient automated test solutions, thereby ensuring accuracy, repeatability, and enhanced software quality.

2. COURSE LEVEL OBJECTIVES

CLO1	To apply automation testing concepts and Selenium commands to develop scripts for testing web applications
CLO2	To apply automation testing concepts and Selenium commands to develop scripts for testing web applications
CLO3	To analyze web application components and identify appropriate Selenium techniques for automating user interactions such as login, navigation, and form submission.
CLO4	To develop automated test cases and test suites using Selenium IDE and Selenium WebDriver for validating different web application functionalities.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply Selenium commands and automation testing techniques to	PO1	Apply L3	WK3, WK4	05

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	design and execute test cases for web applications.				
CO2	Analyze the structure and elements of web applications to identify suitable automation strategies using Selenium tools.	PO2, PO5, PSO1	Apply L3	WK5, WK6	03
CO3	Analyze the structure and elements of web applications to identify suitable automation strategies using Selenium tools.	PO3, PO5, PSO1	Apply L3	WK5, WK6	08
CO4	Evaluate automated test results and handle advanced interactions such as alerts, file uploads/downloads, and test suite execution for effective web testing.	PO8, PO9, PO10	Apply L3	WK5, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Week	Activity	Mapped COs	No. of Hours
1	Understand the automation testing approach(theory concept), Introducing Selenium Commands Installing the IDE, Running Test cases	CO1	02
2	Understand the automation testing approach(theory concept), Introducing Selenium Commands Installing the IDE, Running Test cases	CO1	02
3	Using Selenium IDE, Write a test suite containing minimum 4 test cases.	CO1, CO2	02
4	Create a Selenium script that automates the process of logging into an educational portal, updating personal details, modifying career preferences and navigating various sections of the portal.	CO2	02
5	Create a Selenium script that automates the process of logging into an educational portal, updating personal details, modifying career preferences and navigating various sections of the portal.	CO3	02
6	Write a Selenium script to automate the complete process of searching a flight, entering passenger details, proceeding with payment, and confirming the booking on a flight reservation platform.	CO3	02
7	Develop a Selenium script to automate the key functions of an e commerce platform, including user sign up, login, searching for	CO3	02

	products, adding items to the cart, and completing the purchase process.		
8	Use Selenium and the Robot class to automate the file upload or download functionality, simulating real user interactions with file dialogs in a web application.	CO4	02
9	Create a Selenium script to automate the filling of a Google Form by identifying input fields, dropdowns, radio buttons and submitting the form.	CO3	02
10	Create a Selenium script to handle different types of alerts (simple alert, confirmation alert, and prompt alert) in a web application by accepting, dismissing, and entering text where required.	CO4	02
11	Develop a Selenium TestNG program to automate the login functionality of a web application using multiple sets of credentials. The test data should be provided using TestNG DataProvider to perform data-driven testing and validate login results for each dataset.	CO4	02
12	Write a Selenium TestNG program to execute multiple test cases in parallel to test different webpages simultaneously. Configure the execution using TestNG XML file to improve test execution speed.	CO4	02

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Software Testing: A Craftsman's Approach	Paul C. Jorgensen, Byron De Vries	Auerbach	5 th	All
2	Foundations of Software Testing	Aditya P Mathur	Pearson Education	2 nd	All
3	The Craft of Software Testing: Subsystems Testing Including Object-Based and Object-Oriented Testing	Brian Marrick	Pearson Education	2 nd	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://nptel.ac.in/courses/106/105/106105150>
2. https://onlinecourses.nptel.ac.in/noc19_cs71/preview
3. <https://www.javatpoint.com/selenium-tutorial>
4. Introduction to Selenium - <https://www.youtube.com/watch?v=FRn5J31eAMw>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-
CO3	-	-	3	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	3	2	3	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓		
CO1	3	-
CO2	3	-
CO3	3	-
CO4	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Science and Humanities		
Semester: III to VI	Course Code: BNSK24359/459/559/659	Contact Hrs /week: 02
Course Description: National Service Scheme (NSS)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 28
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

CLO1	Understand the community in general in which they work.
CLO2	Identify the needs and problems of the community and involve them in problem – solving
CLO3	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CLO4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.
CLO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Understand the importance of his / her responsibilities towards society.
CO2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	Implement government or self-driven projects effectively in the field.
CO5	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

3. SYLLABUS

Module No.	Module Description
I	National Service Scheme (NSS) – Contents 1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing. 2. Waste management– Public, Private and Govt organization, 5 R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues. 4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach for implementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education. 7. Developing Sustainable Water management system for rural areas and implementation approaches. 8. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc. 9. Spreading public awareness under rural outreach programs.(minimum 5 programs). 10. Social connect and responsibilities. 11. Plantation and adoption of plants. Know your plants. 12. Organize National integration and social harmony events /workshops /seminars. (Minimum 02 programs). 13. Govt. school Rejuvenation and helping them to achieve good infrastructure.

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Publisher
1	NSS Course Manual	Published by NSS Cell, VTU Belagavi
2	Government of Karnataka, NSS cell, activities reports and its manual.	
3	Government of India, NSS cell, Activities reports and its manual.	





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Department: Science and Humanities		
Semester: III to VI	Course Code: BPEK24359/459/559/659	Contact Hrs /week: 02
Course Description: Physical Education (Sports & Athletics)		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 28
CIE: 100 Marks	SEE: -	Exam Hours: -

1. SYLLABUS

Module No.	Module Description	No. of Hours
I	A. Lifestyle B. Health & Wellness C. Pre-Fitness test.	04
II	A. Warming up (Free Hand exercises) B. Strength – Push-up / Pull-ups C. Speed – 30 Mtr Dash	04
III	1. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus. 2. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.	16

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Department: Science and Humanities		
Semester: III to VI	Course Code: BYOK24359/459/559/659	Contact Hrs /week: 02
Course Description: Yoga		No. of Credits: L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 28
CIE: 100	SEE: -	Exam Hours: -

1. SYLLABUS

Course Title	Content
introduction of Yoga, Aim and Objectives of yoga, Prayer	Yoga, its meaning, definitions. Different schools of yoga, importance of prayer
Brief introduction of yogic practices for common man	Yogic practices for common man to promote positive health.
Rules and regulations	Rules to be followed during yogic practices by practitioner.
Misconceptions of yoga	Yoga its misconceptions
Suryanamaskara	Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar 12 count, 2 rounds.
Different types of Asanas Sitting 1. Padmasana 2. Vajrasana Standing 1. Vrikshana 2. Trikonasana Prone line 1. Bhujangasana 2. Shalabhasana Supine line 1. utthitadvipadasana 2. Ardhalasana	Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits.

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Department: Science and Humanities		
Semester: III to VI	Course Code: BLAK24359/459/559/659	Contact Hrs /week: 02
Course Description: Music		No. of Credits: 0 L : T : P : S = 0:0:2:0
Course Category: MC		Total no. of Hours = 28
CIE: 100 Marks	SEE: -	Exam Hours: -

1. COURSE LEVEL OBJECTIVES

1. Identify the major traditions of Indian music, both through notations and aurally.
2. Analyse the compositions with respect to musical and lyrical content.
3. Demonstrate an ability to use music technology appropriately in a variety of setting.

2. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description
CO1	Discuss the Indian system of music and relate it to other genres (Cognitive Domain)
CO2	Experience the emotions of composer and develop empathy (Affective Domain)
CO3	Respond to queries on various patterns in a composition (Psycho Motor Domain)

3. SYLLABUS

Module No.	Module Description	No. of Hours
I	Preamble: Contents of the curriculum intend to promote music as language to develop on analytical, Creative, and intuitive Understanding. For this the student through study and direct participation in improvisation. Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara. Laya, Raga, Tala, Mela.	03

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II	Compositions: Introduction to the types of composition in Carnatic Music Swarajathi, Varna, Krithi, and Thillana, Notation System.	03
III	Composers: Biography and Contributions of Purandaradasa, Thyagaraja.	03
IV	Music Instruments: Classification and construction of string instruments, percussion instruments, Idiophones (Ghana Vaadya), Examples of each class of Instruments.	3
V	Abhyasa Gana: Singing the swara exercises (Sarale Varase Only), Botation writing for Sarale Varase and Suladi Saptha Tala (Only in Mayamalavagowla Raga), Singing 4 Geethe in Malahari, and one jathi Swara, One Krithi in a Mela raga.	4

4. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

Sl. No.	Name of the Book	Author(s)	Publisher	Edition
1	Theory of Music	Vidushi Vasantha Madhavi	Prism Publication	2007
2	Karnataka Sangeetha Dharpana	T Sachidevi and T Sharadha (Thirumalai Sisters)	Shreenivaas Prakaashana	Vol, 1 2018
3	Classical Music of India: A Practical Gulge	Lakshminarayana Subramaniam, Viji Subramaniam	Tranqueber	2018
4	History of South Indian (Carnatic) Music	R Rangaramanuja Ayyangar	Vipanci Charitable Trust,	Third edition 2019
5	The Story of Indian Music and Its Instruments: A Study of the Present and a Record of the Past	Ethel Rosenthal	Pilgrims Publishing	2007

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Department: Civil Engineering		
Semester: VI	Course Code: BDMP24609	Contact Hrs /week: 02
Course Description: Disaster Management and Preparedness		No. of Credits: 00 L : T : P = 2:0:0
Course Category: NCMC		Total no. of Hours = 30
CIE: 100 Marks	SEE: 0 Marks	Exam Hours: 0
Course Pre-requisites: Basic understanding of environmental and societal issues, Fundamental knowledge of science and engineering concepts.		

1. PREAMBLE ABOUT THE COURSE

To equip students with the knowledge and understanding of disasters, hazards, vulnerability, risk and resilience, and to develop awareness of disaster preparedness, mitigation, response, recovery and rehabilitation measures. The course aims to familiarize students with the legal, institutional and policy frameworks governing disaster management, promote understanding of disaster risk reduction strategies and emerging technologies, and encourage community participation for building a disaster-resilient and sustainable society.

2. COURSE LEVEL OBJECTIVES

Upon successful completion of the course, the students will be able to:

CLO1	To understand the basic concepts of disaster management and disaster risks.
CLO2	To study disaster preparedness, mitigation, and risk reduction measures.
CLO3	To learn disaster response, rescue, recovery, and rehabilitation practices.
CLO4	To understand disaster management policies, institutions, and technologies.
CLO5	To promote community awareness and disaster-resilient practices.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the concepts of disaster, hazard, vulnerability, risk and resilience.	PO1, PO2, PO6, PO7, PO11, PSO1, PSO3	L2	WK1, WK2	6
CO2	Identify various natural and human-induced disasters and assess their impacts on society, economy and environment.	PO1, PO2, PO6, PO7, PO11, PSO1, PSO3	L4	WK2, WK7	6
CO3	Describe disaster preparedness, mitigation, response and recovery strategies.	PO1, PO2, PO3, PO6, PO7, PO9, PO10, PO11, PSO1, PSO2, PSO3	L2	WK3, WK6	6
CO4	Explain disaster governance mechanisms, policies, legal provisions and institutional frameworks	PO1, PO2, PO4, PO5, PO6, PO7, PO10, PO11, PSO1, PSO2	L2	WK4, WK5	6
CO5	Apply disaster management principles for community preparedness and resilience building.	PO1, PO2, PO3, PO6, PO7, PO8, PO9, PO10, PO11, PSO1, PSO2, PSO3	L3	WK2, WK7	6

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Fundamentals of Disaster Management: Concepts of disaster, hazard, vulnerability, exposure, capacity, risk and resilience; classification of disasters including natural, human-induced and technological disasters; disaster profile of India; impacts of disasters on society, economy and environment; disaster management cycle comprising mitigation, preparedness, response, relief, recovery and rehabilitation.	CO1	06
II	Disaster Preparedness and Mitigation: Disaster preparedness planning; hazard identification, risk assessment and hazard mapping; structural and non-structural mitigation measures;	CO2	06

	early warning systems and emergency communication; community-based disaster preparedness; climate change adaptation and disaster risk reduction strategies.		
III	Disaster Response and Recovery: Emergency response mechanisms; search and rescue concepts; relief operations and humanitarian assistance; rehabilitation and reconstruction; Build Back Better approach; public health concerns during disasters; post-disaster recovery planning and management.	CO3	06
IV	Disaster Governance, Policy and Technology: Disaster Management Act, 2005; National Policy on Disaster Management; institutional framework including NDMA, NIDM, SDMA, DDMA and NDRF; roles of IMD, CWC, ISRO and other agencies; applications of GIS, Remote Sensing and Information and Communication Technologies in disaster management; emerging technologies for disaster risk reduction.	CO4	06
V	Community Preparedness and Case Studies: Community participation in disaster management; awareness generation and capacity building; disaster-resilient infrastructure and sustainable development; urban flooding and climate resilience; case studies on earthquakes, floods, cyclones and landslides; lessons learned from major disasters in India.	CO5	06

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

SL. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Introduction to International Disaster Management	D.P. Coppola	Elsevier Science	4th Edition, 2021	I, II, III, IV, V
2	Disaster Management: An Appraisal of Institutional Mechanisms in India	O.S. Dagur	New Century Publications, New Delhi	2011	III, IV
3	Disaster Management Handbook	J. Pinkowski	CRC Press, Taylor & Francis Group	2008	II, III, IV
4	Disaster Management and Mitigation Measures	R. Pagnis	Tech, Knowledge Publications, Pune	2023	II, V
5	Disaster Risk Reduction and Community Resilience	R. Shaw	Springer Publications	Latest Edition	II, V
6	Handbook of Hazards and Disaster Risk Reduction	B. Wisner, J.C. Gaillard and I. Kelman	Routledge Publications	Latest Edition	I, II, V
7	Principles of Emergency Planning and Management	D. Alexander	Oxford University Press	Latest Edition	III, IV

8	National Guidelines on Disaster Management	NDMA	Government of India	Latest Edition	III, IV, V
9	Disaster Management Act	Government of India	Government of India	2005	III, IV
10	Disaster Risk Reduction and Management: Skills for Safety and Resilience	NIDM	Ministry of Home Affairs, Government of India	2025	I, II, III, IV, V

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- National Disaster Management Authority (NDMA) – <https://ndma.gov.in>
- National Institute of Disaster Management (NIDM) – <https://nidm.gov.in>
- India Meteorological Department (IMD) – <https://mausam.imd.gov.in>
- Central Water Commission (CWC) – <https://cwc.gov.in>
- Geological Survey of India (GSI) – <https://gsi.gov.in>
- Indian Space Research Organisation (ISRO) – <https://www.isro.gov.in>
- Indian National Centre for Ocean Information Services (INCOIS) – <https://incois.gov.in>
- India Disaster Resource Network (IDRN) – <https://idrn.gov.in>
- Coalition for Disaster Resilient Infrastructure (CDRI) – <https://cdri.world>
- Building Materials and Technology Promotion Council (BMTPC) – <https://bmtpc.org>
- National Information Centre of Earthquake Engineering (NICEE), IIT Kanpur – <https://www.nicee.org>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓											
CO1	3	2	-	-	-	2	2	-	-	-	1
CO2	3	3	-	-	-	3	2	-	-	-	2
CO3	2	2	2	-	-	3	2	-	2	1	2
CO4	2	2	-	2	2	2	1	-	-	1	2
CO5	2	2	2	-	-	3	3	2	3	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2	PSO3
CO1	2	-	2
CO2	2	-	3
CO3	3	2	2
CO4	2	3	
CO5	3	2	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High



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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24701	Contact Hrs /week: 3
Course Description: Deep Learning and Generative AI		No. of Credits: 03 L : T : P : S = 3 : 0 : 2 : 0
Course Category:		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 3
Course Pre-requisites: • Programming in Python (or equivalent) • Machine Learning Fundamentals		

1. PREAMBLE ABOUT THE COURSE

Deep Learning has emerged as a transformative technology in artificial intelligence and machine learning. This course equips learners with fundamental and advanced neural network concepts, beginning with shallow networks and extending to convolutional, recurrent, and generative models. With the rapid advancements in industry applications like computer vision, natural language processing, reinforcement learning, and autonomous systems, learners gain practical exposure to gradient-based optimization, CNNs, RNNs, transformers, and GANs. By bridging theoretical foundations and hands-on implementation, the course bolsters employability, research readiness, and innovation skills.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamentals of deep learning and Introduce the idea of Artificial Neural Networks and their applications
CLO2	Study and implement various optimization techniques on Artificial Neural Networks
CLO3	Study and implement different deep learning architectures and its applications
CLO4	Understand the principles and challenges of training Generative Adversarial Networks (GANs).

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Implement the fundamentals of ANNs, gradient descent, backpropagation, and activation functions through problem-solving and coding.	PO1, PO2, PO5, PO11, PSO1, PSO2	Apply L3	WK1-WK6	08
CO2	Utilize and experiment with the optimization techniques in Parameter tuning of Deep Learning Models.	PO1, PO2, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK1-WK6, WK8	08
CO3	Apply and analyse CNNs, RNNs, and Transformers in experiments using real-world datasets for classification, captioning and sequence tasks.	PO1, PO2, PO3, PO4, PO5, PO6, PO8, PO9, PO11, PSO1, PSO2	Apply L3	WK1-WK6, WK8	16
CO4	Design deep learning solutions in a mini project for real-world applications.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO11, PSO1, PSO2	Apply L3	WK2-WK6	24

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	MODULE 1	CO1	08
	Introduction to Deep Learning: Machine Learning Basics, Introduction, Deep learning Model, Historical Trends in Deep Learning. Feedforward Networks: Introduction to feedforward neural networks, Artificial neural networks, Shallow neural networks, linear and non-linear activation functions.		
II	MODULE 2 Feedforward Networks: Gradient-Based Learning, Back Propagation and Other Differentiation Algorithms. Regularization for Deep Learning.	CO1, CO2	08

	Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization.		
III	MODULE 3 Basic Optimization Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm. Convolutional Networks: The Convolution Operation, Pooling, Convolution and Pooling as an Infinitely Strong Prior.	CO2, CO3	08
IV	MODULE 4 Convolutional Networks: Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features- LeNet, AlexNet. Recurrent and Recursive Neural Networks: Sequence-to-Sequence model, Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.	CO3	08
V	MODULE 5 Generative AI: Introduction to Generative Deep Learning, Generative Modeling, What Is Generative Modeling? Historical perspective on Generative AI, Autoencoders, Attention Mechanism, Transformer Network, GANs: Generative Adversarial Networks, Generative vs. Discriminative models, Deep Convolution GANs.	CO3	08

List of Programs

CO4	Design deep learning solutions in a mini project for real-world applications.	24
Laboratory Session	1. Implement a shallow and deep ANN using NumPy to apply forward/backpropagation and gradient descent. Analyze how activation functions and learning rates affect performance on a synthetic dataset. 2. Build shallow and deep ANN models in TensorFlow/Keras using tf.GradientTape and Keras APIs. Compare optimizers and activations by plotting decision boundaries on a synthetic dataset. 3. Implement and compare the effects of L2 regularization, dropout, and batch normalization in a deep neural network. Train the models on the MNIST dataset and analyze how these techniques reduce overfitting and improve generalization.	

	4. Apply and compare different optimization algorithms (SGD, SGD with Momentum, RMSProp, Adam) and learning rate decay strategies on a classification task. Use the Fashion-MNIST dataset to evaluate convergence speed and model performance. 5. Implement CNN on MNIST to apply convolution, padding, stride, and pooling operations, and analyze how these building blocks affect feature extraction and classification accuracy. 6. Develop two CNN variants for object detection on a synthetic dataset, applying architectural choices like BatchNorm and Dropout, and analyze their performance using accuracy and IoU metrics. 7. Implement a character-level RNN to perform next-character prediction and generate text, then analyze how varying sequence length influences prediction quality and the vanishing gradient effect. 8. Implement a simple chatbot using LSTM-based sequence modelling and apply generative techniques for response generation in NLP applications. 9. Mini Project – Synopsis 10. Mini project – Review 1 11. Mini project – Review 2 12. Final IA and Project Demo
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Deep Learning (Adaptive Computation and Machine Learning series)	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	2nd Edition, ISBN: 978-0262035613 2016	All
2	Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play	David Foster	O'Reilly Media	2nd Edition, ISBN: 978-1492041948 2023	5
3	Learning deep architectures for A	Bengio, Yoshua	Foundations and trends in Machine Learning	2009	All
4	Neural Networks and Deep Learning- A textbook	Charu C. Aggarwal,	Springer	2018	All

5	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms	Nikhil Buduma,	O'Reilly publications.	-	All
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6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- <https://faculty.iitmandi.ac.in/~aditya/cs671/index.html>
- <https://nptel.ac.in/courses/106/106/106106184/>
- <https://www.youtube.com/watch?v=7x2YZhEj9Dw>
- <https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/leveraging-generative-ai-for-teaching-programming-courses/?v=13b5bfe96f3e>
- <https://www.nielit.gov.in/calicut/content/genai>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →											
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	2	-	-	-	-	-	1
CO2	2	2	-	2	2	-	-	-	-	-	1
CO3	3	3	2	3	3	2	-	2	2	-	2
CO4	3	3	3	3	3	2	1	3	3	2	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →		
COs ↓	PSO1	PSO2
CO1	3	2
CO2	2	3
CO3	3	3
CO4	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24702	Contact Hrs /week: 03
Course Description: Cryptography and Network Security		No. of Credits: 04 L : T : P : S = 3:0:2:0
Course Category: IPCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Basics of Computer Networks		

1. PREAMBLE ABOUT THE COURSE

This course introduces the theoretical concepts and practical applications of cryptography, focusing on securing data and communication in networks.

It covers various cryptographic algorithms, techniques for implementing data security, and common web application vulnerabilities.

2. COURSE LEVEL OBJECTIVES

CLO1	Understanding the concept of Cryptography, Network Security and different Encryption Techniques.
CLO2	Applying the different Block Ciphers and the Data Encryption Standard techniques.
CLO3	Demonstrating the different Public-Key Cryptography and RSA algorithms.
CLO4	Understanding the different Network and Electronic Mail Security techniques used.
CLO5	Analysing the IP, Network Endpoint, Cloud and Internet of Things (IoT) Securities in detail.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Describe the concept of Cryptography, Network Security and different Encryption Techniques.	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Understand L2	WK2-WK4	08

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CO2	Implement different Block Ciphers and the Data Encryption Standard Techniques.	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO3	Demonstrate the different Public-Key Cryptography and RSA algorithms	PO1, PO2, PO3, PO5, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO4	Interpret the different Network and Electronic Mail Security techniques	PO1, PO2, PO3, PO6, PO11, PSO2	Apply L3	WK2-WK4	08
CO5	Examine the security issues in internet protocol, end to end networks, clouds and Internet of Things.	PO1, PO2, PO3, PO6, PO11, PSO2	Apply L3	WK2-WK4	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Information and Network Security Concepts: cybersecurity, information security and network security, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptography, Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition techniques.	CO1	08
II	Block Ciphers and the Data Encryption Standard: Traditional block Cipher structure. The data encryption standard, A DES example, The strength of DES, Block cipher design principles, Advanced Encryption Standard: AES structure, AES transformation Functions, AES Example and Implementation.	CO2	08
III	Public-Key Cryptography and RSA: Principles of public-key cryptosystems, The RSA algorithm, Other Public-Key Cryptosystems: Diffie-Hellman key exchange, Elgamal Cryptographic systems, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	CO3	08
IV	Network and Internet Security: Transport-Level Security: Web Security Considerations, Transport Layer Security, HTTPS, Secure Shell (SSH), Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview and Security, Electronic Mail Security: Internet Mail Architecture, Email Formats, Threats	CO4	08

	and Security, S/MIME, DNSSEC, DNS-Based Authentication of Named Entities, Sender Policy Framework, DomainKeys Identified Mail, Domain-Based Message Authentication, Reporting, and Conformance.		
V	IP Security: IP Security overview and policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Network Endpoint Security: Firewalls, Intrusion Detection Systems, Malicious Software, Distributed Denial of Service Attacks, Cloud Security: Cloud Computing, Cloud Security Concepts, Cloud Security Risks and Countermeasures, Cloud Security as a Service, Internet of Things (IoT) Security: The Internet of Things, IoT Security Concepts and Objectives.	CO5	08

List of Programs

Programs can be written in C/ Java

Sl. No.	Program Description
1	Implement Caesar Cipher encryption & Decryption technique.
2	Implement data encryption and decryption using Hill Cipher method.
3	Demonstrate the working of Play fair Substitution technique.
4	Demonstrate the working of Vigenère Cipher substitution technique.
5	Implement Blowfish symmetric-key algorithm.
6	Write a program to implement Rail fence - Row and column transposition technique.
7	Demonstrate the Data Encryption Standard algorithm using substitution and transposition attributes of cryptography.
8	Execute the program for simple RSA algorithm to encrypt and decrypt the data.
9	Implement Diffie-Hellman Key Exchange algorithm.
10	Demonstrate how packet data is organized and can be accessed using IPv4/6 header.

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cryptography and network security (TB)	William, Stallings.	Pearson Education India, 2006	8th Edition	05



2	Cryptography and Network Security (RB)	Behrouz A.Foruzan	Tata McGraw Hill 2007.	3rd Edition	05
3	Cryptography and Information Security (RB)	V. K Pachghare:	PHI	2nd Edition	05
4	Network Security Essentials: Applications and Standards (RB)	William, Stallings.	Pearson Education India, 2011.	6th Edition	05

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

- <https://nptel.ac.in/courses/106105031>
- https://onlinecourses.nptel.ac.in/noc25_ee54/
- <https://www.coursera.org/learn/network-security-database-vulnerabilities#modules>
- <https://www.coursera.org/learn/networks-and-network-security#modules>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	-	3	1	-	-	-	-	2
CO2	3	3	3	-	3	1	-	-	-	-	2
CO3	3	3	3	-	3	1	-	-	-	-	2
CO4	3	3	1	-	-	1	-	-	-	-	2
CO5	3	3	1	-	-	1	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs →	PSO1	PSO2
COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24703	Contact Hrs /week: 03
Course Description: Cryptocurrency and Blockchain Technology		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PCC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Linear Algebra, Computer Networks		

1. PREAMBLE ABOUT THE COURSE

Blockchain Technology is a transformative paradigm that enables secure, transparent, and decentralized digital systems. This course introduces the fundamental concepts of blockchain and develops the mathematical and cryptographic skills required for secure and trusted operations. It further covers consensus mechanisms, decentralized systems, and cryptocurrencies that enable distributed decision-making. The course also provides exposure to alternative blockchain platforms, development frameworks, and tools for building real-world blockchain applications.

2. COURSE LEVEL OBJECTIVES

CLO1	To provide the basic knowledge of Blockchain Technology.
CLO2	To upskill mathematical and cryptographic skill applicable to Blockchain Technology
CLO3	To gain knowledge of Consensus in Decentralized systems, and crypto currencies.
CLO4	To study the knowledge of alternative blockchains, development framework and tools.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Understand history and basics of blockchain technology.	PO1, PO2, PSO2	Understand L2	WK1, WK2	10

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CO2	Apply the knowledge of mathematical and cryptographic skills on blockchain technology	PO1, PO2, PO3, PSO2	Apply L3	WK3, WK4	12
CO3	Analyse the decentralized based consensus algorithms and cryptocurrencies.	PO1, PO2, PO3, PO5, PSO2	Apply L3	WK5, WK6, WK7	10
CO4	Asses blockchain framework and tools to demonstrate alternative blockchains.	PO1, PO2, PSO2	Apply L3	WK5, WK6, WK7	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Blockchain: Evolution of digital systems, Need for Blockchain Technology, Defining Blockchain, Generic Elements of a Blockchain, How Blockchain works. Decentralization: Decentralization, Requirements of a Decentralizes Applications (DApps), DApp Examples, Platforms for Decentralization. Centralized vs Decentralized vs Distributed Systems, Types of Blockchain: Public, Private, Consortium. CAP Theorem and Blockchain. .	CO1	08
II	Emerging Trends and Applications in Blockchain: Blockchain in Banking & Finance, Supply Chain Management, Healthcare, E-Governance, IoT, Decentralized Finance (DeFi), Challenges and Future Research Directions Blockchain Architecture & Working: Blocks and Block Structure, Blockchain data structure, Transactions and transaction lifecycle, Peer-to-Peer (P2P) Networks, Nodes and Miners, Forks (Soft Fork, Hard Fork).	CO1, CO2	08
III	Cryptographic Foundations: Cryptographic Hash Functions, Digital signatures, Public Key & Private Key Cryptography, Merkle Trees, Hashing, Wallets and Key Management. Blockchain Security & Privacy: Blockchain Security Principles. Common Attacks: Sybil Attack, Double Spending. Privacy Issues in Blockchain: Anonymity and Pseudonymity, Security Challenges and Solutions	CO3	08
IV	Consensus Mechanisms: Safety, Liveness, Nakamoto Consensus, Proof of Burn (PoB), Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Proof of	CO4	08

	Authority (PoA), Practical Byzantine Fault Tolerance (PBFT), Comparison of Consensus Algorithms. Bitcoin: Bitcoin, Digital Keys and addresses, Private and Public Bitcoin, Addresses in Bitcoin, Transactions. Bitcoin Network, Bitcoin Wallets, Bitcoin Installation and Programming, Bitcoin Limitations. Mining, Tasks of Miners, Mining Algorithm.		
V	Smart Contracts & Ethereum: Introduction to Ethereum, Ethereum Virtual Machine (EVM). Smart Contracts: Features and Applications, Gas, Transactions, and Accounts, Solidity Programming Basics, Developing and Deploying Smart Contracts.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Mastering Bitcoin Programming the Open Blockchain,	Andreas M. Antonopoulos	Published by O'Reilly Media	2 nd	1,4
2	Blockchain Technology Concepts and Applications	Kumar Saurabh, Ashuthosh Saxena	Wiley Emerging Technology Series	-	1,2
3	Introduction To Cryptography And Network Security	Behrouz A. Forouzan	Pearson Education	3 rd	3

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. https://onlinecourses.nptel.ac.in/noc22_cs44/preview
2. <https://nptel.ac.in/courses/106104220>
3. <https://nptel.ac.in/courses/106105184>
4. <https://trainingportal.linuxfoundation.org/learn/course/blockchain-understanding-its-uses-and-implications-lfs170/introduction-to-blockchain/introduction-to-blockchain-and-the-early-internet?page=1>



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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	2	-	2	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24704A	Contact Hrs /week: 03
Course Description: Soft Computing		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Artificial Neural Networks		

1. PREAMBLE ABOUT THE COURSE

The course on Soft Computing is designed to introduce students to a collection of methodologies that mimic human intelligence and biological processes to address complex, real-world problems that are often intractable, uncertain, or imprecise for traditional, or "Hard," computational methods.

2. COURSE LEVEL OBJECTIVES

CLO1	Familiarize with soft computing concepts
CLO2	Introduce and use the idea of fuzzy logic and use of heuristics based on human experience
CLO3	Familiarize the Neuro-Fuzzy modeling using Classification and Clustering techniques
CLO4	Learn the concepts of Genetic algorithm and its applications
CLO5	Acquire the knowledge of Rough Sets.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Identify the difference between Conventional Artificial Intelligence to Computational Intelligence.	PO1, PO2, PO3, PSO1, PSO2	Apply L3	WK6, WK8	09
CO2	Understand fuzzy logic and reasoning to handle and solve engineering problems	PO1, PO2, PO3, PO4, PSO1, PSO2	Apply L3	WK6, WK8	09

CO3	Apply the Classification and clustering techniques on various applications.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply L3	WK6, WK8	10
CO4	Understand the advanced neural networks and its applications	PO1, PO2, PO3, PSO1, PSO2	Apply L3	WK1, WK2, WK3	10
CO5	Perform various operations of genetic algorithms, Rough Sets	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply L3	WK4, WK5	10
CO6	Comprehend various techniques to build model for various applications	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK1-WK8	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Soft Computing: Evolutionary Computing, "Soft" computing versus "Hard" computing, Soft Computing Methods, Recent Trends in Soft Computing, Characteristics of Soft computing, Applications of Soft Computing Techniques.	CO1	08
II	Fuzzy Systems: Fuzzy Sets, Fuzzy Relations, Fuzzy Logic, Fuzzy Rule-Based Systems.	CO2	08
III	Fuzzy Decision Making, Particle Swarm Optimization.	CO3	08
IV	Genetic Algorithms: Basic Concepts, Basic Operators for Genetic Algorithms, Crossover and Mutation Properties, Genetic Algorithm Cycle, Fitness Function, Applications of Genetic Algorithm.	CO4, CO6	08
V	Rough Sets, Rule Induction, and Discernibility Matrix, Integration of Soft Computing Techniques.	CO5, CO6	08

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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Soft Computing – Advances and Applications	B.K. Tripathy and J. Anuradha	Cengage Learning	Jan 2015	5
2.	Principles of Soft Computing.	S. N. Sivanandam & S. N. Deepa	Pearson Education	2nd edition, 2008	All
3	Neuro-Fuzzy and Soft Computing	J. S. R. Jang, C.T. Sun and E.Mizutani	Pearson Education	2004	3
4	Fuzzy Sets & Fuzzy Logic	G.J. Klir & B. Yuan,	PHI	1995	4
5	An Introduction to Genetic Algorithm	Melanie Mitchell	PHI	1998	All
6	Fuzzy Logic with Engineering Applications	Timothy J. Ross	McGraw- Hill International editions	1995	All

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <http://www.youtube.com/@introductiontosoftcomputin9462>
2. <https://www.youtube.com/watch?v=3gd1P-uNV-0>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-
CO3	3	3	3	2	2	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	2	2	1	-	-	-	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	1	2
CO2	2	3
CO3	2	3
CO4	1	3
CO5	2	3
CO6	3	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24704B	Contact Hrs /week: 03
Course Description: NoSQL Databases		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Database fundamentals		

1. PREAMBLE ABOUT THE COURSE

The rapid growth of web applications, cloud computing, and big data has exposed the limitations of traditional relational database systems. Modern applications demand scalability, flexibility, and the ability to handle diverse, high-volume, and unstructured data. NoSQL databases have emerged as a powerful alternative to address these challenges.

This subject introduces the concepts, principles, and practices of NoSQL databases, focusing on their differences from relational systems, their aggregate-oriented and schema-less nature, and their application in distributed environments. By studying this subject, learners will understand the motivations behind the rise of NoSQL, explore data modelling strategies suited for real-world applications, and gain insights into the design and operation of scalable, high-performance database systems. The course bridges theoretical foundations with practical use cases, preparing students to apply NoSQL technologies in modern software development and data-driven solutions.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the Motivation and Evolution of NoSQL
CLO2	Analyze and Apply Aggregate-Oriented Data Models
CLO3	Evaluate and Implement Distribution Models
CLO4	Compare Different NoSQL Database Types
CLO5	Develop Competence in MongoDB and Perform Advanced Querying and Indexing in MongoDB

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the need for NoSQL and contrast it with traditional relational databases.	PO1, PO5, PO11, PSO2	Understand L2	WK4,WK6	08
CO2	Illustrate the knowledge of distribution models, replication, sharding, and consistency trade-offs in NoSQL systems.	PO1, PO5, PO11, PSO2	Apply L3	WK5,WK6	08
CO3	Apply the knowledge of key-value, document, column-family, and graph databases to appropriate problem domains.	PO1, PO5, PO11, PSO2	Apply L3	WK4, WK6	08
CO4	Construct MongoDB queries to perform document creation, updating, deletion, querying, and indexing.	PO1, PO3, PO5, PO8, PO9, PO10, PO11, PSO2	Apply L3	WK4, WK6	09
CO5	Apply MongoDB queries to perform querying, and indexing.	PO1, PO3, PO5, PO8, PO9, PO10, PO11, PSO2	Apply L3	WK4, WK6	9

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Why NoSQL? The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL Aggregate Data Models: Aggregates, Key-Value and Document Data Models, Column-Family Stores Summarizing Aggregate-Oriented Databases	CO1	08



	More Details on Data Models: Relationships, Graph Databases, Schema less Databases, Materialized Views, Modelling for Data Access		
II	Distribution Models: Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication, Update Consistency, Read Consistency, Relaxing Durability, Quorums, Key-Value Databases: What Is a Key-Value Store, Key-Value Store Features, Suitable Use Cases, When Not to Use,	CO2	08
III	Document Databases: What Is a Document Database, Features, Suitable Use Cases, When Not to Use Column –Family Stores: What Is a Column Family Data Store, Features, Suitable Use Cases, When Not to Use Graph Databases: What Is a Graph Database, Features, Suitable Use Cases, When Not to Use	CO3	08
IV	Getting Started: Documents, Collections, Databases, Getting and Starting MongoDB, Introduction to the MongoDB Shell, Data Types, Using the MongoDB shell Creating, Updating, and Deleting Documents: Inserting Documents, Removing Documents, Updating Documents	CO4	09
V	Querying: Introduction to find, Query Criteria, Type – Specific Queries, \$where Queries, Cursors Indexes: Introduction to Indexes, explain Output, When Not to Index, Types of Indexes, Index Administration.	CO5	09

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence	Sadalage, P & Fowler	Pearson Addison Wesley	1 st Edition	1, 2, 3
2	MongoDB: The Definitive Guide	Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow,	O'Reilly Media	3rd Edition.	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://learn.mongodb.com/>
2. <https://www.coursera.org/learn/introduction-to-nosql-databases>
3. <https://www.simplilearn.com/free-nosql-course-skillup>
4. <https://nptel.ac.in/courses/106104135>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	2	-	-	-	-	-	2
CO2	3	-	-	-	2	-	-	-	-	-	2
CO3	3	-	-	-	2	-	-	-	-	-	2
CO4	3	-	2	-	2	-	-	1	1	1	2
CO5	3	-	2	-	2	-	-	1	1	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1		2
CO2		2
CO3		2
CO4		2
CO5		2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24704C	Contact Hrs /week: 03
Course Description: Quantum Computing		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Linear Algebra, complex numbers, probability and statistics		

1. PREAMBLE ABOUT THE COURSE

The field of Quantum Computing represents a revolutionary paradigm in computation that leverages the principles of quantum mechanics to process information in ways that classical computers cannot. Unlike classical bits that exist in definite states of 0 or 1, quantum bits (qubits) can exist in superpositions of both states simultaneously, enabling unprecedented computational power for specific classes of problems.

This course introduces the fundamental concepts, mathematical foundations, and algorithms of quantum computation. Students will explore the theoretical framework underlying quantum mechanics, including superposition, entanglement, and quantum measurement, and learn how these principles are used to design quantum circuits and algorithms.

Through hands-on exercises and simulations, learners will gain practical experience in using quantum programming platforms such as IBM Qiskit or Google Cirq. The course also discusses the implications of quantum computing in fields such as cryptography, optimization, and machine learning, and examines the challenges of building scalable quantum hardware.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental principles of quantum mechanics relevant to computation, including superposition, entanglement, and quantum measurement.
CLO2	Explain the conceptual differences between classical and quantum computation, and the significance of qubits and quantum gates.
CLO3	Apply mathematical tools such as linear algebra, complex numbers, and probability theory to analyze and represent quantum systems.
CLO4	Design and simulate simple quantum circuits using standard quantum programming frameworks such as Qiskit or Cirq.
CLO5	Implement and evaluate basic quantum algorithms, including Deutsch–Jozsa, Grover’s Search, and Shor’s Algorithm.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the fundamental principles of quantum mechanics that form the basis of quantum computation.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Understand L2	WK4, WK6	08
CO2	Differentiate between classical and quantum computation models, and describe the role of qubits, superposition, and entanglement.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK5, WK6	08
CO3	Apply linear algebra and probability concepts to represent and manipulate quantum states and operations.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK4, WK6	08
CO4	Construct and simulate quantum circuits using quantum programming tools such as Qiskit or Cirq.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK4, WK6	08
CO5	Implement and test basic quantum algorithms like Deutsch–Jozsa, Grover’s, and Shor’s algorithms.	PO1, PO2, PO3, PO4, PO5, PO11, PSO1, PSO2	Apply L3	WK4, WK6	08

WKS are Washington Accord’s Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Quantum Computation: Classical vs. Quantum Computing, Postulates of Quantum Mechanics, Qubits, Quantum States, and the Bloch Sphere, Superposition and Entanglement, Quantum Measurement and Collapse of the Wavefunction.	CO1, CO2	08

II	Mathematical Foundations: Linear Algebra Review: Vectors, Matrices, Inner Products, Tensor Products, Complex Numbers and Dirac Notation (Bra–Ket notation), Unitary and Hermitian Operators, Probability and Quantum State Transformations, Density Matrices and Mixed States	CO3	08
III	Quantum Gates and Circuits: Single-Qubit Gates: Pauli, Hadamard, Phase, T, and Rotation Gates, Multi-Qubit Gates: CNOT, Toffoli, Swap Gates, Quantum Circuit Representation and Simulation, Quantum Reversibility and Gate Decomposition, Hands-on: Building Circuits in Qiskit / Cirq	CO4	08
IV	Quantum Algorithms: Quantum Parallelism and Oracle Concepts, Deutsch–Jozsa Algorithm, Grover’s Search Algorithm, Shor’s Factoring Algorithm, Quantum Fourier Transform (QFT), Simulation Exercises using Qiskit	CO5	08
V	Advanced Topics and Applications: Quantum Error Correction and Decoherence, Quantum Cryptography (BB84, E91 protocols), Quantum Machine Learning (QML) – Introduction, Quantum Communication and Networks, Hardware Platforms: Superconducting Qubits, Trapped Ions, Future Directions and Research Challenges	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Quantum Computation and Quantum Information	Michael A. Nielsen & Isaac L. Chuang	Cambridge University Press.	1 st Edition	1, 2, 3
2	Introduction to Quantum Computing	Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow,	Springer	3rd Edition.	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

- [IBM Quantum – What is Quantum Computing? \(YouTube\)](https://learn.mongodb.com/)<https://learn.mongodb.com/>
- <https://chatgpt.com/c/69075a80-523c-8324-87e9-446dfd4c9dbc#:~:text=Qiskit%20YouTube%20Channel%20%E2%80%93%20Quantum%20Basics%20Series>
- [https://chatgpt.com/c/69075a80-523c-8324-87e9-446dfd4c9dbc#:~:text=NPTEL%20%E2%80%93%20Introduction%20to%20Quantum%20Computing%20by%20Prof.%20Ashwin%20Nayak%20\(IIT%20Kanpur\)](https://chatgpt.com/c/69075a80-523c-8324-87e9-446dfd4c9dbc#:~:text=NPTEL%20%E2%80%93%20Introduction%20to%20Quantum%20Computing%20by%20Prof.%20Ashwin%20Nayak%20(IIT%20Kanpur))

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	1	1	1	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	2	3	3	2	3	-	-	-	-	-	2
CO5	3	3	3	3	3	-	-	-	-	-	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 – High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24704D	Contact Hrs /week: 03
Course Description: Multicore Architecture		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: PEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: DLD, CO, Basic Programming Concepts, Operating System		

1. PREAMBLE ABOUT THE COURSE

This course focuses on *quantitative design principles* and *performance metrics*. It explores *parallelism* across multiple architectural levels. It connects *multicore*, *GPU*, *cloud*, and *embedded systems* into one cohesive framework. It develops *analytical and evaluation skills* for modern computing architectures.

2. COURSE LEVEL OBJECTIVES

CLO1	To understand the fundamental principles of quantitative computer design and performance evaluation.
CLO2	To explain various forms of parallelism and the evolution from single-core to multicore systems.
CLO3	To explore and analyze data-level parallelism using vector, SIMD, and GPU-based architectures.
CLO4	To examine thread-level parallelism and challenges in multiprocessor systems.
CLO5	To evaluate large-scale computing architectures and embedded systems for scalability and efficiency.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain quantitative principles of computer design, performance metrics, and dependability.	PO1, PO2, PO3, PSO1	Understand L2	WK1, WK2	08

CO2	Demonstrate the limitations of single-core processors and justify the need for parallelism through ILP, DLP, TLP, and RLP.	PO1, PO2, PO3, PSO1	Apply L3	WK2, WK3	08
CO3	Analyze data-level parallelism using vector, SIMD, and GPU architectures to improve performance.	PO1, PO3, PO4, PSO2	Apply L3	WK3, WK4	08
CO4	Evaluate thread-level parallelism, synchronization, and memory consistency in multiprocessor systems.	PO1, PO2, PO4, PO5, PSO2	Apply L3	WK4, WK5	08
CO5	Assess architectural design trade-offs in warehouse-scale and embedded systems for efficiency and scalability.	PO1, PO3, PO5, PSO2	Apply L3	WK5, WK6, WK7	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Fundamentals Of Quantitative Design And Analysis: Classes of Computers , Trends in Technology, Power, Energy and Cost, Dependability, Measuring, Reporting and Summarizing Performance, Quantitative Principles of Computer Design, Classes of Parallelism, ILP, DLP, TLP and RLP, Multithreading, SMT and CMP Architectures, Limitations of Single Core Processors, The Multicore era, Case Studies of Multicore Architectures.	CO1	08
II	DLP in Vector, SIMD and GPU Architectures: Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, Detecting and Enhancing Loop Level Parallelism, Case Studies.	CO2	08
III	TLP and Multiprocessors: Symmetric and Distributed Shared Memory Architectures, Cache Coherence Issues, Performance Issues, Synchronization Issues, Models of Memory Consistency, Interconnection Networks, Buses, Crossbar and Multi, stage Interconnection Networks.	CO3	08
IV	RLP and DLP in Warehouse, Scale Architectures: Programming Models and Workloads for Warehouse, Scale Computers , Architectures for Warehouse, Scale Computing,	CO4	08

	Physical Infrastructure and Costs, Cloud Computing, Case Studies.		
V	Architectures for Embedded Systems: Features and Requirements of Embedded Systems, Signal Processing and Embedded Applications, The Digital Signal Processor, Embedded Multiprocessors, Case Studies.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Computer Architecture: A Quantitative Approach	John L. Hennessy and David A. Patterson,	Morgan Kaufmann / Elsevier	5th Ed., 2012	1, 2, 3, 4
2	Advanced Computer Architecture	Kai Hwang	Tata McGraw, Hill Education	2003	1, 2, 3, 5
3	Advanced Computer Architecture a Systems Design Approach	Richard Y. Kain	Prentice Hall	2011	3, 5
4	Parallel Computing Architecture : A Hardware/ Software Approach	David E. Culler, Jaswinder Pal Singh	Morgan Kaufmann / Elsevier	1997	2, 4

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://nptel.ac.in/courses/106/102/106102062/>
2. <https://nptel.ac.in/courses/106/101/106101007/>
3. <https://www.coursera.org/learn/heterogeneous-parallel-programming>
4. <https://www.edx.org/course/parallel-computing>
5. https://swayam.gov.in/nd1_noc20_cs46/
6. <https://www.edx.org/course/embedded-systems-essentials-with-arm>

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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-
CO3	3	-	3	2	-	-	-	-	-	-	-
CO4	3	3	-	2	3	-	-	-	-	-	-
CO5	2	-	3	-	3	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	-	3
CO5	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24705A	Contact Hrs /week: 03
Course Description: Computational Data Science		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Statistical Tools and Python		

1. PREAMBLE ABOUT THE COURSE

This course introduces the fundamental concepts of Computational Data Science, integrating computational thinking with data analysis, statistics, and machine learning. Students develop skills in data collection, cleaning, modeling, and interpretation using modern computational tools and platforms. The course emphasizes real-world applications, scalable data-driven solutions, and ethical data use, preparing students for further study in data science and analytics.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand the fundamental concepts of computational data science and data-driven problem solving.
CLO2	Collect, clean, and organize data using basic data handling techniques.
CLO3	Apply elementary statistical methods and introductory machine learning techniques to examine datasets.
CLO4	Analyze large-scale datasets using big data and cloud computing tools to identify patterns and insights.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Apply computational thinking in formulating data-driven solutions.	PO1, PO2, PO3, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK5, WK6	08



CO2	Pre-process and visualize data effectively for analysis and perform Hypothesis Testing.	PO1, PO2, PO3, PO4, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK6	16
CO3	Analyze the performance of machine learning algorithms to extract insights for predictive analytics.	PO1, PO2, PO3, PO4, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK5, WK6	9
CO4	Examine large datasets using Big data and cloud computing concepts to identify patterns and trends.	PO1, PO2, PO3, PO4, PO5, PSO1, PSO2	Apply L3	WK2, WK3, WK4, WK6	9

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

M o d u l e N o.	Module Description	M a p p e d C o u r s e s	N o o f H o u r s
I	Introduction to Computational Data Science Overview of Data Science – definitions, scope, applications. Computational thinking – decomposition, abstraction, pattern recognition, algorithms. Data Science lifecycle – CRISP-DM.	C O 1	0 8
II	Data Handling & Preprocessing Data types, formats, structured/unstructured/streaming data. Data acquisition: APIs, web scraping, databases. Data cleaning – missing values, outliers, duplicates. Feature engineering.	C O 2	0 8
III	Computational & Statistical Foundations Probability, random variables, distributions. Sampling & hypothesis testing. Linear algebra essentials. Optimization concepts – gradient descent, cost functions.	C O 2	0 8
IV	Machine Learning for Data Science	C O 3	0 9

	Supervised learning – regression (linear, logistic), decision trees, SVM. Unsupervised learning – clustering (K-Means, Hierarchical), dimensionality reduction (PCA). Model evaluation – confusion matrix, ROC, precision, recall, F1-score. For Demonstration: Overfitting/underfitting, cross-validation.		
V	Big Data & Computational Platforms Big data concepts. Hadoop ecosystem – HDFS, MapReduce, YARN. Spark fundamentals – RDDs, Data Frames. NoSQL databases – MongoDB, Cassandra. For Demonstration: Cloud-based data science – AWS/GCP/Azure basics.	C O 4	0 9

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Practical Data Science with Python	Nathan George, David Taieb	Addison-Wesley	1 st	All
2	Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data	EMC Education Services	John Wiley & Sons Ltd	1 st	1, 2 & 5
3	Mathematics for Machine Learning	Marc Deisenroth	Cambridge University Press	1 st	3 & 4
4	Designing Data-Intensive Applications	Martin Kleppmann	O'Reilly Media	1 st	4, 5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. [https://soclibrary.futa.edu.ng/books/Practical%20Data%20Science%20with%20Python%20\(Nathan%20George\)%20\(Z-Library\).pdf](https://soclibrary.futa.edu.ng/books/Practical%20Data%20Science%20with%20Python%20(Nathan%20George)%20(Z-Library).pdf)
2. <https://www.coursera.org/specializations/data-science-python>
3. <https://www.coursera.org/learn/machine-learning>
4. <https://nptel.ac.in/courses/106/106/106106179>
5. <https://towardsdatascience.com>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	-	-	-	-	-	-	-	-
CO2	3	3	2	3	-	-	-	-	-	-	-
CO3	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	2	3
CO4	1	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24705B	Contact Hrs /week: 03
Course Description: Data Visualization using Tableau and Power BI		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: -		

1. PREAMBLE ABOUT THE COURSE

In today's data-driven world, organizations rely heavily on business intelligence tools to analyze and visualize vast volumes of data for informed decision-making. Tableau and Power BI are two of the leading data visualization platforms that enable users to transform raw data into meaningful insights through interactive dashboards, charts, and reports.

Tableau is known for its intuitive drag-and-drop interface, real-time analytics, and powerful visualization capabilities, making it popular among data analysts and business users alike. On the other hand, Power BI, developed by Microsoft, integrates seamlessly with other Microsoft products and offers robust data modeling, transformation, and sharing features.

This course/module aims to equip learners with the skills to collect, clean, analyze, and visualize data using Tableau and Power BI. By mastering these tools, learners will be empowered to uncover trends, support business strategies, and communicate data effectively in professional environments.

2. COURSE LEVEL OBJECTIVES

CLO1	Understand and apply data visualization principles using Tableau and Power BI for effective decision-making and business insights.
CLO2	To develop proficiency in connecting, transforming, and analyzing data from various sources using built-in features of Tableau and Power BI.
CLO3	To equip learners with the skills to design interactive dashboards and reports that communicate data findings clearly to stakeholders.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the fundamentals of Tableau data source connectivity.	PO1, PO5, PO11	Understand L2	WK2, WK6	06
CO2	Apply Tableau terminologies and calculation techniques to analyse the datasets.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08
CO3	Implement sorting, filtering, grouping, hierarchy, and set operations in Tableau to refine and organize data for effective analysis.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	10
CO4	Design appropriate charts, plots, and maps in Tableau by selecting suitable visual encodings to effectively represent data patterns.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08
CO5	Apply basic Power BI concepts and DAX expressions to create visualizations for data analysis.	PO1, PO2, PO3, PO5, PO11, PSO1	Apply L3	WK2, WK6	08

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction: What is Tableau? History of Tableau, Advantages and disadvantages of Tableau, Connecting to data source, Files and folders, Tableau navigation.	CO1	06
II	Tableau Terminologies: Data types, Data roles, Data aggregation, File types. Tableau calculations: Operators, Functions, Numeric, string, date, table calculations, Level of Details expressions.	CO2	08
III	Sort and filter: Basic filters, Filter operations, Extract filters, Quick filters, Context filters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets.	CO3	10

IV	Charts and Plots: Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts, Scatter plot, Boxplot. Maps: Heat map, Tree map.	CO4	08
V	Introduction to Power BI: Getting started with Power BI Desktop, Creating basic visualizations, Introduction to DAX functions, Creating calculated columns and measures using DAX.	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Pro Tableau - A Step-by-Step Guide	Seema Acharya, Subhashini Chellappan	Apress	1 st	1, 2, 3, 4
2	Tableau 10 Business Intelligence Cookbook	Donabel Santos	Packt Publishing	1 st	1, 2, 3, 4
3	Microsoft Power BI for Dummies	Jack Hyman	For Dummies	1 st	5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.udemy.com/course/tableau-data-visualization-starttech>
2. <https://www.tableau.com/learn>
3. <https://www.besanttechnologies.com/power-bi-training-course>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	1	-	-	-	-	-	1
CO2	2	3	2	-	1	-	-	-	-	-	1
CO3	2	3	2	-	1	-	-	-	-	-	1
CO4	2	2	3	-	1	-	-	-	-	-	1
CO5	2	3	2	-	1	-	-	-	-	-	1

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24705C	Contact Hrs /week: 03
Course Description: Cyber Security and Ethical Hacking		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: Programming knowledge, Computer Networks, Operating Systems, Web Technologies		

1. PREAMBLE ABOUT THE COURSE

Cybersecurity and ethical hacking is crucial for students because it protects their personal information, learning environment, and well-being in the digital age. It helps prevent cyberbullying, data breaches, and identity theft, while also fostering digital literacy and responsible online behaviour. In essence, cybersecurity and ethical hacking is not just about protecting data; it's about creating a safe, secure, and empowering learning environment for students in the increasingly digital world

2. COURSE LEVEL OBJECTIVES

CLO1	To familiarize cybercrime terminologies and perspectives.
CLO2	To understand Cyber Offenses and Botnets.
CLO3	To gain knowledge on tools and methods used in cybercrimes.
CLO4	To realize the basics of ethical hacking, footprinting and reconnaissance.
CLO5	To apprehend the network scanning ideas used by the hackers.

3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Explain the cybercrime terminologies	PO1, PO2, PO5, PO6, PO7, PO11, PSO2	Understand L2	WK2, WK4, WK7	08

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CO2	Describe Cyber offenses and Botnets	PO1, PO2, PO5, PO6, PO7, PO11, PSO2	Understand L2	WK2, WK4, WK7	08
CO3	Discuss Tools and Methods used on Cybercrime	PO1, PO2, PO5, PO6, PO7, PO11, PSO2	Understand L2	WK2, WK4, WK7	08
CO4	Discriminate the hackers and ethical hackers	PO1, PO2, PO5, PO6, PO7, PO11, PSO2	Understand L2	WK2, WK4, WK7	08
CO5	Identifying the network scanning strategies used by the hackers.	PO1, PO2, PO5, PO6, PO7, PO11, PSO2	Understand L2	WK2, WK4, WK7	08

WKs are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives	CO1	08
II	Cyber Offenses: How Criminals Plan Them: Introduction, how criminals plan the attacks, Social Engineering, Cyber Stalking, Cybercafé & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector	CO2	08
III	Tools and Methods used in Cybercrime: Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDOS Attackers, Attacks on Wireless networks	CO3	08
IV	Introduction: What is ethical hacking? Types of hacking, advantages, disadvantages and purpose of hacking, Types of hackers, Code of ethics, Types of attacks and attack vector types, Prevention from hackers, Phases of hacking. <u>Footprinting and Reconnaissance.</u> What is footprinting? Active and passive footprinting, purpose of footprinting, objectives of footprinting, footprinting threats, Types of footprinting, footprinting countermeasures	CO4	08

V	Scanning networks: Network scanning and its types, objectives of network scanning, scanning live systems, scanning techniques-TCP Connect / Full Open Scan, Types of Stealth scans, port scanning countermeasures, IDS evasion techniques, Banner grabbing and its tools, vulnerability scanning, proxy servers, anonymizers, IP spoofing and its countermeasures.	CO5	08
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5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives	Sunit Belapure and Nina Godbole	Wiley India Pvt Ltd	First Edition (Reprinted 2018)	1,2,3
2	Internet Security Fundamentals	Nick Ioannou	Tata Mc Graw Hill	10th Anniversary Edition	2
3	Managing Cybersecurity Risk: Cases Studies and Solutions Paperback	Jonathan Reuvid	Wiley India Pvt Ltd	2018	3
4	Cyber Security and Cyber Laws	Nilakshi Jain Ramesh Menon	Wiley India Pvt Ltd	2021	1,2,3
5	CEH Certified Ethical Hacker	MATT WALKER	Mc Graw Hill Education	FOURTH EDITION	4,5
6	Ethical Hacking	Umesh Waghmare, Diana Fernandes, Mitali Shewale, Anjali Gaikwad Lakhamade B.K. Birla, Dr. Priti Pathak	Mumbai University Press,	2022	4,5

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE]

1. <https://www.cyberdegrees.org/resources/free-online-courses>
2. <https://www.my-mooc.com/en/categorie/cybersecurity>
3. <https://www.coursera.org/courses?query=cybersecurity>

4. <https://www.cybrary.it/course/ethical-hacking/>
5. <https://shorturl.at/5mRK0>
6. <https://www.classcentral.com/course/swayam-ethical-hacking-14045>

7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	3	2	1	-	-	-	3
CO2	3	2	-	-	3	2	1	-	-	-	3
CO3	3	2	-	-	3	2	1	-	-	-	3
CO4	3	2	-	-	3	2	1	-	-	-	3
CO5	3	2	-	-	3	2	1	-	-	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High



Head of Department
Computer Science Engineering
Central Academy of Technology
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Department: Computer Science and Engineering		
Semester: VII	Course Code: BCS24705D	Contact Hrs /week: 03
Course Description: Full Stack Framework – Backend Tools		No. of Credits: 03 L : T : P : S = 3:0:0:0
Course Category: OEC		Total no. of Hours = 40
CIE: 50 Marks	SEE: 50 Marks	Exam Hours: 03
Course Pre-requisites: JavaScript, HTML		

1. PREAMBLE ABOUT THE COURSE

The Full Stack Framework (Backend) course equips students with the core skills required to design, develop, and deploy scalable and secure backend applications using modern JavaScript technologies. The course focuses on Node.js, Express.js, and MongoDB to build efficient server-side applications and RESTful APIs. Students gain hands-on experience in backend server development, database integration, authentication and authorization using JWT, and performance optimization techniques such as filtering, pagination, and sorting. By the end of the course, learners will be able to develop industry-ready backend systems following best practices and modern development standards.

2. COURSE LEVEL OBJECTIVES

CLO1	Demonstrate the ability to install and configure Node.js and Visual Studio Code, and understand the basic concepts and benefits of using Node.js in modern web development
CLO2	Design and implement an Express server that can serve static assets, HTML, and JSON, and understand the principles of routing and middleware in Express applications.
CLO3	Set up a MongoDB database, create Mongoose models, and develop RESTful API endpoints for creating, reading, updating, and deleting resources, with appropriate data validation and sanitization.
CLO4	Apply best practices for securely storing passwords, use JSON Web Tokens (JWT) for authentication, and protect API endpoints with middleware to ensure data security and user privacy
CLO5	Apply techniques for sorting, filtering, and paginating data to manage large datasets effectively and ensure efficient data retrieval in web applications.

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3. COURSE OUTCOMES (COs) & COMPETENCIES

After completing the course, Students would be able to:

Course Outcome	Description	Mapped POs/PSOs	Cognitive Level	WK	Class Hours
CO1	Install Node.js and Visual Studio Code, understand the role of Node.js in web development, and write and execute basic Node.js scripts	PO1, PO5, PO11, PSO1	Apply L3	WK3, WK4, WK6	06
CO2	Set up an Express server, serve static files, and handle HTTP requests for different content types, including HTML, JSON, CSS, JS, and images	PO2, PO3, PO5, PO9, PSO1	Apply L3	WK3, WK4, WK6	06
CO3	Install MongoDB, setting up Mongoose, and performing CRUD operations using a RESTful API with proper data validation and sanitization	PO1, PO2, PO3, PO4, PO5, PSO1	Apply L3	WK2, WK3, WK4, WK6	10
CO4	Securely handle user authentication, including password management, JWT generation and validation, and implementing middleware for protecting API routes.	PO1, PO3, PO5, PO7, PO8, PO9, PSO1	Apply L3	WK4, WK6, WK7, WK9	10
CO5	Implement effective data management strategies, including sorting, filtering, and paginating data to enhance application performance and user experience.	PO2, PO3, PO4, PO5, PO10, PO11, PSO1, PSO2	Apply L3	WK2, WK4, WK6, WK8	8

Wks are Washington Accord's Knowledge & Attitude Profiles ranging from WK1 to WK9

4. SYLLABUS

Module No.	Module Description	Mapped COs	No. of Hours
I	Installing and Exploring Node.js: Installing Node.js and Visual Studio Code, What is Node.js? Why Should I Use Node.js? Your First Node.js Script Text Book: 1 - Chapters: 2	CO1	08

II	Web Server: Hello Express!, Serving up HTML and JSON, Serving up Static Assets, Serving up CSS, JS and Images Text Book: 1 - Chapters: 7	CO2	08
III	MongoDB and REST APIs: Installing MongoDB on Windows, Setting up Mongoose, Creating a Mongoose Model, Data Validation and Sanitization, Structuring a REST API, Installing Postman, Resource Creation Endpoints, Resource Reading Endpoints, Resource Updating Endpoints, Resource Deleting Endpoints Text Book: 1 - Chapters: 10, 11	CO3	08
IV	API Authentication and Security: Securely Storing Passwords, Logging in Users, JSON Web Tokens, Generating Authentication Tokens, Express Middleware, Accepting Authentication Tokens, Logging Out, Hiding Private Data, Authenticating User Endpoints Text Book: 1 - Chapters: 12	CO4	08
V	Sorting, Pagination, and Filtering: Filtering Data, Paginating Data, Sorting Data Text Book: 1 - Chapters: 13	CO5	08

5. LIST OF RECOMMENDED AND REFERENCE TEXTBOOKS

S. No.	Name of the Book	Author(s)	Publisher	Edition	Modules Covered
1	The Complete Node.js Developer Course	Andrew Mead, Rob Percival	Packt Publishing, ISBN: 9781789955071	3rd	1, 2, 3, 4, 5
2	Beginning Node.js	Basarat Ali Syed	Apress	1st	
3	Node.JS Web Development	David Herron	Packt Publishing	1st	
4	Node.js Design Patterns	Mario Casciaro	Packt Publishing	1st	

6. LIST OF ONLINE RESOURCES [NPTEL/SWAYAM/MOOCs/WEB RESOURCE

1. <https://www.anuragkapur.com/assets/blog/programming/node/PDF-Guide-Node-Andrew-Mead-v3.pdf>
2. <https://www.udemy.com/course/the-complete-nodejs-developer-course-2/?couponCode=ST10MT8624>


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Computer Science Engineering
 Global Academy of Technology
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Computer Science Engineering
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7. COURSE OUTCOMES & PROGRAM OUTCOMES MAPPING

POs → COs ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	2	-	-	-	-	-	2
CO2	-	2	3	-	2	-	-	-	1	-	-
CO3	3	2	3	2	2	-	-	-	-	-	-
CO4	2	-	3	-	2	-	2	1	1	-	-
CO5	-	2	2	2	2	-	-	-	-	1	2

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High

8. COURSE OUTCOMES & PROGRAM SPECIFIC OUTCOMES MAPPING

PSOs → COs ↓	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Correlation Weightage: 1 – Low, 2 – Moderate, 3 - High


 Head of Department
 Computer Science Engineering
 Global Academy of Technology
 Bangalore - 98


 Professor & Associate Dean Academics
 Global Academy of Technology
 Bengaluru - 560098.