YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY

SCHOOL OF COMPUTER SCIENCE

UGP05: Bachelor of Computer Applications
{2025 Pattern}
SYLLABUS
Semester I to III

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YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY

SCHOOL OF COMPUTER SCIENCE

UGP05: Bachelor of Computer Applications {2025 Pattern}

SYLLABUS

With effect from Academic Year 2025-26, vide G.R. No. NEP-2022/CR No. 09/VISHI-3/शिकाना, dated 20-April-2023.

With effect from Academic Year 2025-26, vide All India Council for Technical Education's Draft Model Curriculum for UG Degree in Bachelor in Computer Applications BCA/BCA(Honours)/BCA(Honours with Research) 2024

Yashwantrao Chavan Maharashtra Open University
Dnyangangotri, Near Gangapur Dam,
Nashik – 422 222

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Yashwantrao Chavan Maharashtra Open University

Vice-Chancellor: Prof. Sanjeev Sonawane

School of Computer Science

Director of the School:

Prof. Chetana Kamlaskar (I/C) (from 31-January-2026)

Mr. Madhav Palshikar (till 31-January-2026)

Programme Advisory Committee Members

UGP05: Bachelor of Computer Applications {2025 Pattern} and Open Elective Courses

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- **Uploaded** on University Website on 12-September-2026

PAC meeting held on 13-March-2025.
School Council Meeting held 05-June-2025 (B-1/F-178/2025/04: Syllabus)
Academic Council Meeting held on 21-July-2025 (Approval for School Council meeting held on 05-June-2025) (Item No. 68.3.7).

SYLLABUS FOR UGP05: Bachelor of Computer Applications {2025 Pattern}

About the Programme:

Programme Code: UGP05
Programme Name: Bachelor of Computer Applications {2025 Pattern}

In today's digital world, computers and information technology play an important role in almost every field including education, business, healthcare, banking, communication, transportation, entertainment, and government services. The BCA programme has been designed to prepare students for this rapidly growing technological environment by providing strong theoretical knowledge along with practical computer skills.
The BCA programme is a three-year undergraduate degree programme that aims to develop competent IT professionals with sound knowledge of computer applications, programming, software development, database systems, networking, web technologies, and emerging computing concepts. The programme focuses on both academic learning and skill development so that students become capable of handling real-world technological challenges.
The School of Computer Science believes that quality computer education should be accessible to all learners irrespective of their geographical location or professional background. Through the flexible learning system of the university, students are provided an opportunity to pursue higher education while continuing their personal, professional, or social responsibilities.

This programme is designed to achieve the following objectives, outcomes, and scope.

Objectives of the Programme

The objectives of the Bachelor of Computer Applications programme are:

- To provide students with fundamental and advanced knowledge in computer science and computer applications.
- To develop programming, analytical, and problem-solving abilities among learners.
- To create awareness about modern information technologies and their applications in various sectors.
- To equip students with practical skills required for software development, database management, networking, and web technologies.
- To prepare students for employment opportunities in the Information Technology industry.
- To encourage logical thinking, creativity, innovation, and continuous learning.
- To prepare students for higher studies and research in computer science and related disciplines.
- To make quality computer education available through flexible and learner-friendly open and distance learning mode.

Programme Outcomes (POs):

After successful completion of this programme, students will be able to:

- Apply Computer Science Fundamentals
- Develop Proficiency in Programming and Software Development
- Manage Databases and Data Analytics
- Understand Computer Networks and Cybersecurity
- Work with Artificial Intelligence and Emerging Technologies
- Engage in Lifelong Learning and Career Advancement

Scope of the Programme:

After successful completion of the BCA programme, students can explore career opportunities in various areas such as:

- Software Development
- Web Development
- Mobile Application Development
- Database Administration
- Computer Networking
- System Administration
- Cybersecurity
- Data Analytics
- Cloud Computing

Graduates of the programme may work in software companies, educational institutions, banks, government organizations, private industries, IT service companies, startups, and various digital enterprises.

The programme also provides a strong foundation for higher education.

Basic Information:

1. **Mode of Education**: Blended Mode
2. **Learner Support Centers/ Study Centers:** University approved LSC/SCs.
3. **Medium of Instruction**: English
4. **Teaching-Learning**: 15 working weeks per semester
5. **Total Teaching-Learning Support: 550** hours in each semester.
6. **Total Courses: Minimum 56 and Maximum 57** courses (subjects) for **3 Years** under Graduate degree

Semester	Minimum	Maximum
I	8	8
II	8	8
III	12	12
IV	10	10
V	9	10
VI	9	9
Total →	56	57

7. **Total Credits: 132** Credits for 3 years Under Graduate degree

   As per UGC norms 1 Credit means 30 hours of study efforts required to gain learning of particular content of each credit.
8. **Semester Credits**: 22 Credits in each semester
9. **Passing**: Minimum 40%
10. **Continuous Assessment**: Continuous Assessment conducted for Continuous evaluation during teaching-learning for 30% Weightage Theory type of courses, 50% weightage for Practical type of courses and 100% weightage for CC, CEP, FP type of courses.
11. **End Exam**: End Examination conducted for Summative evaluation of the student for 70% Weightage for Theory type of courses and for 50% Weightage for practical type of courses.
12. **Multiple Entry Multiple Exit Option**:

    Compliance with MS G.R. No. NEP-2022/CR No. 09/VISHI-3/शिकाना, dated 20-April-2023.

Sr. No.	Level of the Programme	Entry Option (with criteria) [Note: As per BCA Prospectus June 2025]	Exit Option (with criteria)
1	Certificate Level	1. Qualifying marks in Common Entrance Test conducted by the university **AND** 2. 12th standard of HSC Board of Maharashtra, or equivalent [including MCVC] **OR** 2. 3-year Diploma of Board of Technical Examination or equivalent **OR** 2. 2-year ITI Programme of any trade after 10th standard **OR** 2. 2-year course of Maharashtra State Board of Vocational Education after 10th.	Award of UG Certificate in the Faculty of Computer Science – Computer Applications (Level 4.5) with 44 credits and an additional 4 credits core NSQF course/Internship
2	Diploma Level	UG Certificate in the Faculty of Computer Science – Computer Applications (Level 4.5) with 44 credits and an additional 4 credits core NSQF course/Internship	Award of UG Diploma in the Faculty of Computer Science – Computer Applications (Level 5.0) with 88 credits and an additional 4 credits core NSQF course/ Internship
3	Degree Level	UG Diploma in the Faculty of Computer Science – Computer Applications (Level 5.0) with 88 credits and an additional 4 credits core NSQF course/ Internship	Award of UG Degree with 132 credits

13. **Certification:** Min "P(Pass)" or better grade in all courses (subjects) of total **132** credits at Semesters 01-06 for Under Graduate Programme.

14. **Curriculum Design**: Student centric curriculum is designed to enable professional ability, employability and skill enhancement.
15. **Approval/Equivalence Status**: UGC and DEB recognized and approved [AY 2023 and onwards] with UGC/DEB letter F.No. 30-30/2023 (DEB-II), Dated: 13.11.2024, available at https://deb.ugc.ac.in/pdf/HomePageRecognitionDetail/140/140_upload_RecognitionDetails_202502181 45348.pdf

PROGRAMME STRUCTURE AND CREDIT DISTRIBUTION OF BACHELOR OF COMPUTER APPLICATIONS

BCA

First Year (Note: As it is from BCA Prospectus June 2025 pattern)

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	4- 6 (4+2)	-	-	2+2	VSC:2, SEC:2	AEC:2, VEC:2, IKS:2	CC:2	20-22	UG Certificate 40-44
	I	BCAC101: Problem Solving Techniques (Theory - 4 credits) AND BCAC102: Mathematics (Theory – 4 credits)	-	-	-	SEC: 2 BCAS101: Lab: Problem Solving Techniques (Practical – 4 credits) AND VSC: 2 BCAV101: Advanced Excel (Practical – 2 credits)	AEC: 2 AECL101: Listening and Speaking Skills in English (Theory – 2 credits) AND VEC: 2 VECD101: Introduction to the Constitution of India (Theory – 2 credits) AND IKS: 2 Select any one from IKSK104 and IKSK105 1. IKSK104: भारतीय ज्ञान परंपरेच्या अनुषंगाने विज्ञान आणि तंत्रज्ञान (Theory – 2 credits) OR 2. IKSK105: Indian Knowledge System – Generic (2 credits) (Offered in Online Mode)	CCRX101 to CCRX106 (2 credits)	-	
	I	4+4=8	-	-	0	4+2=6	2+2+2=6	2	8+4+6+2=22	
	II	4- 6 (4+2)		2	2+2	VSC:2, SEC:2	AEC:2, VEC:2	CC:2	20-22	
	II	BCAC103: Data Structure using C++ (Theory – 4 credits) AND BCAC104: Web Technology (Theory – 4 credits) AND BCAC105: Operating System (Theory – 4 credits)	-			VSC: 2 BCAV102: Lab: Web Technology (Practical – 2 credits) AND SEC: 2 BCAS102: Lab: Data Structure using C++ (Practical - 2 credits)	AEC: 2 AECL102: Reading and Writing Skills in English (Theory – 2 credits) AND VEC: 2 VECD102: Environmental Education (Theory – 2 credits)	CCRX107 to CCRX112 (2 credits)		
	II	4+4+4=12	-	0	0	2+2=4	2+2=4	2	6+4+4+2=22	
	I+II	8+12=20	-	0	0	4+4=8	6+4=10	2+2=4	22+22=44	
Award of UG Certificate in the Faculty of Computer Science – Computer Applications (Level 4.5) with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue										

BCA

First Year (Note: As it is from BCA Prospectus June 2025 pattern, few Course Names modified in green colour)

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
4.5	I	4- 6 (4+2)	-	-	2+2	VSC:2, SEC:2	AEC:2, VEC:2,IKS:2	CC:2	20-22	UG Certificate 40-44
	I	BCAC101: Problem Solving Techniques (Theory - 4 credits) **AND** BCAC102: Mathematics (Theory – 4 credits)	-	-	-	**SEC: 2** BCAS101: Lab on Problem Solving Techniques (Practical – 4 credits) **AND** **VSC: 2** BCAV101: Advanced Excel (Practical – 2 credits)	**AEC: 2** AECL101: Listening and Speaking Skills in English (Theory – 2 credits) **AND** **VEC: 2** VECD101: Introduction to the Constitution of India (Theory – 2 credits) **AND** **IKS: 2** **Select any one from IKSK104 and IKSK105** 3. IKSK104: भारतीय ज्ञान परंपरेच्या अनुषंगाने विज्ञान आणि तंत्रज्ञान (Theory – 2 credits) **OR** 4. IKSK105: Indian Knowledge System – Generic (2 credits) (Offered in Online Mode)	**CCRX101** to **CCRX106** (2 credits)	-	
	I	**4+4=8**	**-**	**-**	**0**	**4+2=6**	**2+2+2=6**	**2**	**8+4+6+2=22**	
	Semester	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr./ Sem.**	
		Mandatory	**Electives**							
	II	**4- 6 (4+2)**		**2**	**2+2**	**VSC:2, SEC:2**	**AEC:2, VEC:2**	**CC:2**	**20-22**	
	II	BCAC103: Data Structures using C++ (Theory – 4 credits) **AND** BCAC104: Web Technology (Theory – 4 credits) **AND** BCAC105: Operating System (Theory – 4 credits)	-			**VSC: 2** BCAV102: Lab on Web Technology (Practical – 2 credits) **AND** **SEC: 2** BCAS102: Lab on Data Structures using C++ (Practical - 2 credits)	**AEC: 2** AECL102: Reading and Writing Skills in English (Theory – 2 credits) **AND** **VEC: 2** VECD102: Environmental Education (Theory – 2 credits)	**CCRX107** to **CCRX112** (2 credits)		
	II	**4+4+4=12**	**-**	**0**	**0**	**2+2=4**	**2+2=4**	**2**	**6+4+4+2=22**	
	I+II	**8+12=20**	**-**	**0**	**0**	**4+4=8**	**6+4=10**	**2+2=4**	**22+22=44**	
Award of UG Certificate in the Faculty of Computer Science – Computer Applications (Level 4.5) with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue										

BCA (Second Year)

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	6(4+2)-8(2*4)	-	4	2	VSC:2,	AEC:2	FP:2, CC:2	20-22	UG Diploma 80-88
		BCAC241: Database Management Systems (Theory – 2 credits) **AND** BCAC202: Data Science and IKS (Theory – 2 credits)		Courses to be aligned as per Minor stream selected **here** in **Semester III**, from **1. Artificial Intelligence** **2. Internet of Things** Choose any **ONE** from Choose any **ONE** from AISM101 and IOTM101 AISM101: Fundamentals of AI (Theory – 2 credits) **OR** IOTM101: Fundamentals of IoT (Theory – 2 credits) **AND** AISM201: Machine Learning and Deep Learning (Theory – 2 credits) **AND** AISM202: Lab on Machine Learning (Practical – 2 credits) **OR** IOTM201: IoT Hardware and Software (Theory – 2 credits) **AND** IOTM202: Lab on Microcontrollers (Practical – 2 credits)	MATE104: Statistics for Research (Theory – 2 credits) **AND** XXXE201: Select from other faculty OE courses List (Theory – 2 credits)	**VSC: 2** BCAV201: Lab on Database Management Systems (Practical – 2 credits)	**AEC-MIL Course** **Select Any one from AECL201 , AECL203 and AECL205** AECL201: Aadhunik Marathi Bhasha Abhyas– I (Theory – 2 credits) **OR** AECL203: Aadhunik Hindi Bhasha Ka Adhyayan– I (Theory – 2 credits) **OR** AECL205: UrduShayari: Kawayed aur Balagat Ka Mutala (Theory – 2 credits)	**FP:2** BCAF204: Field Project (Field Project – 2 credits) **AND** **CC: 2** **CCRX201** to **CCRX206** (2 credits)		
		CSC101: **Cyber Security** (Theory – Non-credit Audit Course)	-	-	-	-	-	-	-	
	III	**2+2=4**	-	**2+(2+2)=6**	**2+2=4**	**2**	**2**	**2+2=4**	**4+6+4+2+2+4=22**	
	Semester	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr./ Sem.**	
		Mandatory	**Electives**							
	IV	**6(4+2)-8(2*4)**		**4**	**2**	**SEC:2**	**AEC:2**	**CEP: 2, CC:2**	**20-22**	
		BCAC205: Python Programming (Theory - 4 credits) **AND** BCAC242: Computer Networks (Theory – 2 credits)	-	Courses as per ONE Minor stream selected in **Semester III**, from 1. Artificial Intelligence 2. Internet of Things AISM203: Fuzzy Logic and Expert Systems (Theory – 2 credits) **AND** AISM204: Lab on Fuzzy Logic (Practical – 2 credits) **OR** IOTM203: Networking and Connectivity (Theory – 2 credits) **AND** IOTM204: Lab on IoT Network (Practical – 2 credits)	XXXE103: Select from other faculty OE courses List (Theory – 2 credits) **AND** XXXE202: Select from other faculty OE courses List (Theory – 2 credits)	**SEC:2** BCAS201: Lab on Python Programming (Practical - 2 credits)	**AEC – MIL Course** **Select Any one from AECL202 , AECL204 and AECL206** AECL202: Aadhunik Marathi Bhasha Abhyas– II (Theory – 2 credits) **OR** AECL204: Aadhunik Hindi Bhasha Ka Adhyayan– II (Theory – 2 credits) **OR** AECL206: UrduNasra:Zuban aur Kawayed Ka Mutala (Theory – 2 credits)	**CEP: 2** BCAG207: Community Engagement Programme (Practical – 2 credits) **AND** **CC:2** **CCRX207** to **CCRX212** (2 credits)		
	IV	**4+2=6**	-	**2+2=4**	**2+2=4**	**2**	**2**	**2+2=4**	**6+4+4+2+2+4=22**	
	III+IV=	**4+6=10**	-	**6+4=10**	**4+4=8**	**2+2=4**	**2+2=4**	**4+4=8**	**44**	
	FY+SY	**20+10=30**	-	**10**	**8**	**8+4=12**	**10+4=14**	**4+8=12**	**44+44=88**	
Exit option: Award of UG Diploma in the Faculty of Computer Science - Computer Applications (Level 5.0) with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

BCA (Third Year)

Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr./ Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.5	V	8(2*4)-10 (2*4 +2)	4	4-6	-	VSC: 2-4	-	FP/CEP: 2	20-22	UG Degree 120-132
		BCAC301: Java Programming (Theory – 4 credits) AND BCAC319: Software Engineering (Theory – 2 credits) AND BCAC320: Lab on Software Engineering (Practical – 2 credits)	BCAC304: Design and Analysis of Algorithms (4 credits) OR BCAC305: Data Warehousing and Data Mining (Theory – 2 credits) AND BCAC306: Lab on Data Warehousing and Data Mining (Practical - 2 credits)	Courses as per ONE Minor stream selected in **Semester III**, from 1. Artificial Intelligence 2. Internet of Things AISM301: Natural Language Processing (NLP) (Theory – 2 credits) AND AISM302: Lab on Natural Language Processing (NLP) (Practical – 2 credits) OR IOTM301: IoT Data Management and Analytics (Theory – 2 credits) AND IOTM302: Lab on IoT Data Management (Practical – 2 credits)	XXXE102: Select from other faculty OE courses List (Theory – 2 credits)	VSC - 2 BCAV301: Lab on Java Programming (Practical – 2 credits)	-	BCAF307: Field Project (Field Project – 2 credits) OR BCAG308: Community Engagement Programme (2 credits)		
	V	4+(2+2)=8	2+2=4	2+2=4	2	2	-	2	8+4+4+2+2+2=22	
	VI	8(2*4)-10 (2*4 +2)	4	4	-	-	-	OJT :4	20-22	
		BCAC321: Advanced Java (Theory – 4 credits) AND BCAC322: Lab on Advanced Java (Practical – 2 credits) AND BCAC323: Big Data Analytics (Theory – 2 credits) AND BCAC324: Lab on Big Data Analytics (Practical – 2 credits)	BCAC325: Cloud Computing (Theory – 2 credits) And BCAC326: Lab on Cloud Computing (Practical – 2 credits) OR BCAC327: Android Programming (Theory – 2 credits) And BCAC328: Lab on Android Programming (Practical – 2 credits)	Courses as per ONE Minor stream selected in **Semester III**, from 1. Artificial Intelligence 2. Internet of Things AISM303: Generative AI (Theory – 2 credits) AND AISM304: Capstone Project on AI OR IOTM303: Industrial IoT (Theory – 2 credits) AND IOTM304: Capstone Project on IoT (Practical – 2 credits)	-	-	-	BCAO329: On Job Training (4 credits)		
	VI	(4+2)+(2+2)=10	2+2=4	2+2=4	-	-	-	4	10+4+4+4=22	
	V+VI	8+10=18	4+4=8	4+4=8	2	2	-	2+4=6	18+8+8+2+2+6=44	
Exit option: Award of UG Degree in Computer Applications (Level 5.5) with 132 credits										

UGPO5: BACHELOR OF COMPUTER APPLICATIONS STRUCTURE (MIX OF UGC NEP PATTERN+AICTE PATTERN)

A) Structure

First Year - Semester I (Level 4.5) (as it is 2025 pattern)												
Course Code	**Category**	**Course Name**	**Theory/ Practical/ Project**	**Total Study (HRS)**	**Credit Points**	**Medium**	**Assessment Type CA Max**	**Assessment Type CA Min**	**Assessment Type EE/UA Max**	**Assessment Type EE/UA Min**	**Total Marks Max**	**Total Marks Min**
BCAC101	Major (Core)	Problem Solving Techniques	Theory	120	4	English	30	12	70	28	100	40
BCAC102	Major (Core)	Mathematics	Theory	120	4	English	30	12	70	28	100	40
BCAS101	SEC	Lab on Problem Solving Techniques	Practical	120	4	English	50	20	50	20	100	40
BCAV101	VSC	Advanced Excel	Practical	60	2	English	25	10	25	10	50	20
AECL101	AEC	Listening and Speaking Skills in English	Theory	60	2	English	15	6	35	14	50	20
VECD101	VEC	Introduction to the Constitution of India	Theory	60	2	English	15	6	35	14	50	20
Select any one from IKSK104 And IKSK105												
IKSK104	IKS	भारतीय ज्ञान परंपरेच्या अनुषंगाने विज्ञान आणि तंत्रज्ञान	Theory	60	2	Marathi	15	6	35	14	50	20
IKSK105	IKS	Indian Knowledge System – Generic	Offered in Online mode		2	Marathi	15	6	35	14	50	20
CCRX101 to CCRX106	CC	Choose from CC list (Annexure F)	Practical	60	2	-	50	20	-	-	50	20
				Total	**22**						**550**	**220**
First Year - Semester II (Level 4.5) (as it is 2025 pattern)												
Course Code	**Category**	**Course Name**	**Theory/ Practical/ Project**	**Total Study (HRS)**	**Credit Points**	**Medium**	**Assessment Type CA Max**	**Assessment Type CA Min**	**Assessment Type EE/UA Max**	**Assessment Type EE/UA Min**	**Total Marks Max**	**Total Marks Min**
BCAC103	Major (Core)	Data Structures using C++	Theory	120	4	English	30	12	70	28	100	40
BCAC104	Major (Core)	Web Technology	Theory	120	4	English	30	12	70	28	100	40
BCAC105	Major (Core)	Operating System	Theory	120	4	English	30	12	70	28	100	40
BCAV102	VSC	Lab on Web Technology	Practical	60	2	English	25	10	25	10	50	20
BCAS102	SEC	Lab on Data Structures using C++	Practical	60	2	English	25	10	25	10	50	20
AECL102	AEC	Reading and Writing Skills in English	Theory	60	2	English	15	6	35	14	50	20
VECD102	VEC	Environmental Education	Theory	60	2	English	15	6	35	14	50	20
CCRX107 to CCRX112	CC	Choose from CC list (Annexure F)	Practical	60	2	-	50	20	-	-	50	20
				Total	**22**						**550**	**220**
Award of UG Certificate in the Faculty of Computer Science – Computer Applications (Level 4.5) with 44 credits and an additional 4 credits core NSQF course/Internship OR Continue												

Second Year - Semester III (Level 5.0)												
Course Code	**Category**	**Course Name**	**Theory/ Practical/ Project**	**Total Study (HRS)**	**Credit Points**	**Medium**	**Assessment Type CA Max**	**Assessment Type CA Min**	**Assessment Type EE/UA Max**	**Assessment Type EE/UA Min**	**Total Marks Max**	**Total Marks Min**
BCAC241	Major Mandatory	Database Management Systems	Theory	60	2	English	15	6	35	14	50	20
BCAC202	Major Mandatory	Data Science and IKS	Theory	60	2	English	15	6	35	14	50	20
Select any ONE Minor stream from 1. Artificial Intelligence 2. Internet of Things Choose any ONE from AISM101 and IOTM101												
AISM101	Minor	Fundamentals of AI	Theory	60	2	English	15	6	35	14	50	20
IOTM101	Minor	Fundamentals of IoT	Theory	60	2	English	15	6	35	14	50	20
Continue with the Minor stream as selected in Semester III, from 1. Artificial Intelligence 2. Internet of Things												
AISM201	Minor	Machine Learning and Deep Learning	Theory	60	2	English	15	6	35	14	50	20
AISM202	Minor	Lab on Machine Learning	Practical	60	2	English	25	10	25	10	50	20
IOTM201	Minor	IoT Hardware and Software	Theory	60	2	English	15	6	35	14	50	20
IOTM202	Minor	Lab on Microcontrollers	Practical	60	2	English	25	10	25	10	50	20
MATE104	Open Elective Course	Statistics for Research	Theory	60	2	-	15	6	35	14	50	20
XXXE202	Open Elective Course	Select from **other faculty** OE courses List	Theory	60	2	-	15	6	35	14	50	20
BCAV201	VSC	Lab on Database Management Systems	Practical	60	2	English	25	10	25	10	50	20
AEC-MIL Course Select Any one from AECL201 ,AECL203 and AECL205												
AECL201	AEC	Aadhunik Marathi Bhasha Abhyas– I	Theory	60	2	Marathi	15	6	35	14	50	20
AECL203	AEC	Aadhunik Hindi Bhasha Ka Adhyayan– I	Theory	60	2	Hindi	15	6	35	14	50	20

AECL205	AEC	Urdu Shayari: Kawayed aur Balagat Ka Mutala	Theory	60	2	Urdu	15	6	35	14	50	20
BCAF204	Field Project	Field Project	Field Project	60	2	-	50	20	-	-	50	20
Select any one from CCRX201 to CCRX206												
CCRX201	CC	Health and Wellness-III	Practical	60	2	-	50	20	-	-	50	20
CCRX202	CC	Yoga Education-III	Practical	60	2	-	50	20	-	-	50	20
CCRX203	CC	Sports and Fitness-III	Practical	60	2	-	50	20	-	-	50	20
CCRX204	CC	Cultural Activities-III	Practical	60	2	-	50	20	-	-	50	20
CCRX205	CC	NSS-III	Practical	60	2	-	50	20	-	-	50	20
CCRX206	CC	Fine/Applied/Visual/Performing Arts-III	Practical	60	2	-	50	20	-	-	50	20
CSC101	Audit	Cyber Security	Theory	-	-	English	15	6	35	14	50	20
				Total	**22**						**550**	**220**

Second Year - Semester IV (Level 5.0)

Course Code	Category	Course Name	Theory/ Practical/ Project	Total Study (HRS)	Credit Points	Medium	Assessment Type CA Max	Assessment Type CA Min	Assessment Type EE/UA Max	Assessment Type EE/UA Min	Total Marks Max	Total Marks Min
BCAC205	Major Mandatory	Python Programming	Theory	120	4	English	30	12	70	28	100	40
BCAC242	Major Mandatory	Computer Networks	Theory	60	2	English	15	6	35	14	50	20
Continue with the Minor stream as selected in Semester III, from 1. Artificial Intelligence 2. Internet of Things												
AISM203	Minor	Fuzzy Logic and Expert Systems	Theory	60	2	English	15	6	35	14	50	20
AISM204	Minor	Lab on Fuzzy Logic	Practical	60	2	English	25	10	25	10	50	20
IOTM203	Minor	Networking and Connectivity	Theory	60	2	English	15	6	35	14	50	20
IOTM204	Minor	Lab on IoT Network	Practical	60	2	English	25	10	25	10	50	20
XXXE203	Open Elective Course	Select from **other faculty** OE courses List	Theory	60	2	-	15	6	35	14	50	20
XXXE204	Open Elective Course	Select from **other faculty** OE courses List	Theory	60	2	-	15	6	35	14	50	20
BCAS201	SEC	Lab on Python Programming	Practical	60	2	English	25	10	25	10	50	20
AEC – MIL Course Select Any one from AECL202 ,AECL204 and AECL206												
AECL202	AEC	Aadhunik Marathi Bhasha Abhyas– II	Theory	60	2	Marathi	15	6	35	14	50	20
AECL204	AEC	Aadhunik Hindi Bhasha Ka Adhyayan– II	Theory	60	2	Hindi	15	6	35	14	50	20
AECL206	AEC	Urdu Nasra: Zuban aur Kawayed Ka Mutala	Theory	60	2	Urdu	15	6	35	14	50	20
BCAG207	CEP	Community Engagement Programme	Practical	60	2	-	50	20	-	-	50	20
Select any one from CCRX207 to CCRX212												
CCRX207	CC	Health and Wellness-IV	Practical	60	2	-	50	20	-	-	50	20
CCRX208	CC	Yoga Education-IV	Practical	60	2	-	50	20	-	-	50	20
CCRX209	CC	Sports and Fitness-IV	Practical	60	2	-	50	20	-	-	50	20
CCRX210	CC	Cultural Activities-IV	Practical	60	2	-	50	20	-	-	50	20
CCRX211	CC	NSS-IV	Practical	60	2	-	50	20	-	-	50	20
CCRX212	CC	Fine/Applied/Visual/Performing Arts-IV	Practical	60	2	-	50	20	-	-	50	20
				Total	**22**						**550**	**220**

Exit option: Award of UG Diploma in the Faculty of Computer Science - Computer Applications (Level 5.0) with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

Third Year - Semester V (Level 5.5)

Course Code	Category	Course Name	Theory/ Practical/ Project	Total Study (HRS)	Credit Points	Medium	Assessment Type CA Max	Assessment Type CA Min	Assessment Type EE/UA Max	Assessment Type EE/UA Min	Total Marks Max	Total Marks Min
BCAC301	Major Mandatory	Java Programming	Theory	120	4	English	30	12	70	28	100	40
BCAC319	Major Mandatory	Software Engineering	Theory	60	2	English	15	6	35	14	50	20
BCAC320	Major Mandatory	Lab on Software Engineering	Practical	60	2	English	25	10	25	10	50	20
Elective Course Select Any one from BCAC304 or (BCAC305 and BCAC306)												
BCAC304	Major Elective	Design and Analysis of Algorithms	Theory	120	4	English	30	12	70	28	100	40
BCAC305	Major Elective	Data Warehousing and Data Mining	Theory	60	2	English	15	6	35	14	50	20
BCAC306	Major Elective	Lab on Data Warehousing and Data Mining	Practical	60	2	English	25	10	25	10	50	20
Continue with the Minor stream as selected in Semester III, from 1. Artificial Intelligence 2. Internet of Things												
AISM301	Minor	Natural Language Processing (NLP)	Theory	60	2	English	15	6	35	14	50	20
AISM302	Minor	Lab on Natural Language Processing (NLP)	Practical	60	2	English	25	10	25	10	50	20
IOTM301	Minor	IoT Data Management and Analytics	Theory	60	2	English	15	6	35	14	50	20
IOTM302	Minor	Lab on IoT Data Management	Practical	60	2	English	25	10	25	10	50	20
XXXE301	Open Elective Course	Select from **other faculty** OE courses List	Theory	60	2	-	15	6	35	14	50	20
BCAV301	VSC	Lab on Java Programming	Practical	60	2	English	25	10	25	10	50	20
Select Any one from BCAF307 or BCAG309												
BCAF307	Field Project	Field Project	Field Project	60	2	English	50	20	-	-	50	20
BCAG308	CEP	Community Engagement Programme	Practical	60	2	-	50	20	-	-	50	20

				Total	**22**	**-**					**550**	**220**
Third Year - Semester VI (Level 5.5)												
Course Code	**Category**	**Course Name**	**Theory/ Practical/ Project**	**Total Study (HRS)**	**Credit Points**	**Medium**	**Assessment Type CA Max**	**Assessment Type CA Min**	**Assessment Type EE/UA Max**	**Assessment Type EE/UA Min**	**Total Marks Max**	**Total Marks Min**
BCAC321	Major Mandatory	Advanced Java	Theory	120	4	English	30	12	70	28	100	40
BCAC322	Major Mandatory	Lab on Advanced Java	Practical	60	2	English	10	10	25	10	50	20
BCAC323	Major Mandatory	Big Data Analytics	Theory	60	2	English	15	6	35	14	50	20
BCAC324	Major Mandatory	Lab on Big Data Analytics	Practical	60	2	English	10	10	25	10	50	20
Elective Course Select Any one from (BCAC325 and BCAC326) or (BCAC327 and BCAC328)												
BCAC325	Major Elective	Cloud computing	Theory	60	2	English	15	6	35	14	50	20
BCAC326	Major Elective	Lab on Cloud computing	Practical	60	2	English	25	10	25	10	50	20
BCAC327	Major Elective	Android Programming	Theory	60	2	English	15	6	35	14	50	20
BCAC328	Major Elective	Lab on Android Programming	Practical	60	2	English	25	10	25	10	50	20
Continue with the Minor stream as selected in Semester III, from 1. Artificial Intelligence 2. Internet of Things												
AISM303	Minor	Generative AI	Theory	60	2	English	15	6	35	14	50	20
AISM304	Minor	Capstone Project on AI	Practical	60	2	English	25	10	25	10	50	20
IOTM303	Minor	Industrial IoT	Theory	60	2	English	15	6	35	14	50	20
IOTM304	Minor	Capstone Project on IoT	Practical	60	2	English	25	10	25	10	50	20
BCAO329	OJT	On Job Training	On Job Training	120	4	English	50	20	50	20	100	40
				Total	**22**	**-**					**550**	**220**
Exit option: Award of UG Degree in Computer Applications (Level 5.5) with 132 credits												

[**Abbreviations** –
VSC – Vocational Skill Course,
SEC – Skill Enhancement Course,
AEC – Ability Enhancement Course,
VEC – Value Education Course,
IKS – Indian Knowledge System,
CEP – Community Engagement Programme,
OJT – On Job Training,
FP – Field Project,
CC – Co-Curricular]

SEMESTER I

Detailed Syllabus

Course details

Course Code	Course	Category	Course Type	Credits
BCAC101	Problem Solving Techniques	Major (Core)	Theory	4

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
14	12	120	2	30 marks	70 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Apply the fundamental concepts of computer organization, problem-solving techniques, and structured programming principles to design logical solutions using flowcharts and algorithms.

CO2: Develop C programs using variables, operators, control structures, arrays, strings, functions, and pointers to solve computational problems efficiently.

CO3: Implement advanced C programming features such as structures, unions, file handling, storage classes, and preprocessor directives to manage data and program execution effectively.

CO4: Demonstrate debugging skills, error handling, and proper program documentation to ensure correctness, maintainability, and clarity of C programs.

CO–PO Mapping Matrix

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2				2
CO2	2	3				2
CO3	2	3	2			2
CO4	2	3				2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Title	Details
Unit 1	Introduction to Computer	• Computer Fundamentals: Introduction to Computers: Characteristics of Computers, Uses of computers, Types and generations of Computers. • Basic Computer Organization: Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices
Unit 2	Techniques of Problem Solving	• Concept of problem solving, Problem definition, Program design • Flowcharting, decision table, algorithms, Structured programming concepts
Unit 3	Planning the Computer Program	• Programming methodologies viz. top-down and bottom-up programming • Debugging, Types of errors in programming, Documentation

Unit 4	Introduction to C	• History of C
		• C Basics
		  ○ C character set, tokens, constants, variables, keywords, identifiers
		  ○ C operators- arithmetic, logical, assignment, relational, increment and decrement, conditional, bit wise, special, operator precedence, C expressions data types.
		• Problem solving techniques: flowchart and algorithm

Unit 5	Managing Input & output operations	• Reading a character, writing a character, formatted input, formatted output.
Unit 6	Decision Making and looping	• Decision making and branching if-statement–if, if- else, else-if ladder, nested if else, switch case statement, break statement • Decision making and looping- while, do, do-while statement, for loop, continue statement
Unit 7	Arrays	• Arrays Declaration and initialization of one dimensional, two Dimensional and character arrays, accessing array elements.
Unit 8	Strings	• Declaration and initialization of string variables, string handling functions from standard library – strlen(), strcpy(), strcat(), strcmp()
Unit 9	Functions	• Need of functions, scope and lifetime of variables, defining functions, function call, call by value, call by reference, return values, storage classes. category of function- No argument No return value, No argument with return value, argument with return value, recursion, Command Line Arguments
Unit 10	Pointers	• Understanding pointers, declaring pointer variable, initialization of pointer variable, accessing address of a variable, pointer expressions, Pointers arithmetic

Unit 11	Structures and Unions	• Structures: Defining structure, declaring and accessing structure members, initialization of structure, arrays of structure, Difference between array and structure. • Union: Defining Union, declaring and accessing union members, Difference between structure and union
Unit 12	File handling	• Introduction to Streams • Type of files • Operation on text files • Standard Library • Input Output function
Unit 13	Storage Classes	• Scope and extent • Storage Classes in a single source file • auto, extern and static, register
Unit 14	The C Preprocessor	• Features of C Preprocessor • Macro Expansion • Macros with Arguments • Macros versus Functions • File Inclusion • Conditional Compilation

Course details

Course Code	Course	Category	Course Type	Credits
BCAS101	Lab on Problem Solving Techniques	SEC	Practical	4

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
24	12	120	50 marks	50 marks

1 session = 2 clock hours

Course Outcomes (COs)

CO1: Design logical solutions using flowcharts and algorithms for computational problems.

CO2: Apply decision-making and control structures (if, conditional operators, switch) to solve selection-based problems.

CO3: Implement iterative constructs (loops, recursion) to perform repetitive computations such as factorial, palindrome, and reverse operations.

CO4: Use arrays and strings to solve problems involving searching, sorting, aggregation (sum/average), and matrix operations.

CO5: Apply functions (with parameters, return values, recursion, and call by reference) to develop modular and reusable C programs.

CO–PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2				2
CO2	2	3				2
CO3	2	3				2
CO4	2	3	2			2
CO5	2	3				2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Practical No.	Title	Details
1)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to perform the mathematical operations such as addition, subtraction, multiplication, division and mod of two numbers.
2)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to find area and perimeter of a rectangle.
3)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to find area and circumference of a circle.
4)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to find area of triangle given base and height.
5)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to find the sum of the digits of 3-digit number.
6)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to reverse a 3-digit number
7)	Flowchart and Algorithm and basics of 'C	Write an Algorithm, draw a flowchart and write a program to convert a temperature in Fahrenheit (F) to its equivalent in Celsius(C) [c= (f-32)*5/9 , f= 9/5*c+32]
8) **C2 - 8.1**	if statement	Write a program to find greatest among three numbers using if statement.
8) **8.2**	if statement, Conditional operator	Write a program to find greatest among three numbers using conditional operator
9)	Use of switch statement and concept of loops	Write a program to input a character and decide whether it is a vowel or not. Try to use toupper() or tolower() to ignore the character case of the vowels.
10)	concept of loops, for , do-while, while-do	Write a program to calculate factorial of a number.
11)	Use of do-while	Write a program to find sum and average of 'n' numbers.
12) **12.1**	Concept of Arrays	Write a menu driven program to create one dimensional array, display it, find the sum of all the elements, find maximum and minimum element within the array, include the facility to search an element. Finally sort the array.

12) **12.2**	Concept of Arrays	Write a program to create two arrays, find sum and difference of these two matrices.
12) **C3 - 13.1**	Strings	Write a program to implement various string functions.
13) **13.2**	Strings	Write a program to enter a string and decide whether it is palindrome or not.
14) **14.1**	Functions	Write a menu driven program to convert dollars to rupees and rupees to dollars using functions.
14) **14.2**	Functions	Write a program using functions to find reverse of a number and decide whether it is palindrome or not. Develop two functions getnum() and reverse() with proper prototypes.
15)	Recursion	Write a program to calculate factorial of number using recursion.
16)	Pointers	Write a program to swap the values of two variables by using call by reference method in functions.
17)	Structures	Write a program using the concept of array of structures to create a list of students having the following fields rollno, name, marks[3], total Marks should be stored as an integer array.
18)	Unions	Write a program to create a structure stock, having member fields as manufacturer, itemname, desc, (desc must be union either refer to it by size or colour.) Store data for ‘n’ products.
19)	File Handling	Write a program to create a text file “L1.txt“ which stores a line of text till the user presses the enter. Copy this file into “L2.txt“
20) **C4-20**	File Handling	Write a menu driven program to create a structure ‘employee’ having members as empid, name and basic pay. Using functions create(), add(), display() perform various operations.
21)	File Handing	Write a program to create a file org.txt, replace every character in it by its next character, store this file in encrypt.txt.
22)	Storage Classes	Write a program to implement the Concept of storage classes.
23)	Storage classes	Write a program to generate Fibonacci series using functions and, in the function, try to use the concept of static storage class for the first two terms.
24)	C pre-processor	Write a macro ‘design’ to create a pattern using for loop.

Course details

Course Code	Course	Category	Course Type	Credits
BCAC102	Mathematics	Major (Core)	Theory	4

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
14	12	120	2	30 marks	70 marks

1 Counselling = 1 clock hour

Course Outcomes (COs)

CO1: Apply concepts of sets, relations, functions, logic, and mathematical induction to model and analyze computational problems.

CO2: Perform operations with number systems, exponents, surds, logarithms, and algebraic expressions to solve mathematical problems.

CO3: Utilize principles of counting, permutations and combinations, matrices, determinants, linear equations, polynomials, vectors, and quadratic equations in problem-solving.

CO4: Analyze and apply concepts of graph theory and geometry (areas, perimeters, volumes, and surface areas) in mathematical and real-life contexts.

CO–PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2				2
CO2	3	2				2
CO3	3	3	2			2
CO4	2	2				2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Title	Details
Unit 1	Set Theory	• Relevance of Mathematics • Set Notations, Types of sets, Set Operations, Properties of Set operations, Venn Diagrams
Unit 2	Number Systems	• Binary Number System, Conversion between Binary and Decimal Number System, Addition and Subtraction of Binary Numbers, Octal Number System, Hexadecimal Number System
Unit 3	Mathematical Induction	• Mathematical Induction: First Principle, Proofs of statements using mathematical induction
Unit 4	Mathematical Logic	• Mathematical Logic: Statement, Truth value of a Statement, Types of logical statements, Types of Compound Statements, Logically Equivalent Statements, Logical Identities, Tautology and Contradiction
Unit 5	Exponents, Surds	• Exponential form and Laws of Exponents • Laws of Fractional Exponents, Surd, Order of Surd, Forms of surds
Unit 6	Logarithms	• Logarithm, Antilogarithm, Conversion to different base, Application of Logarithms in Complex Calculations
Unit 7	Permutations and Combinations	• Addition Principle, Multiplication Principle • Factorial of Number • Permutations and Combinations
Unit 8	Relations	• Cartesian Product of Sets, Relations, Types of Relations • Equivalence Relations and Equivalence Classes • Matrix of a Relation
Unit 9	Functions	• Functions, Types of Functions, Composition of Functions
Unit 10	Vectors	• Vectors, Types of Vectors, Algebra of Vectors, Collinear and Coplanar Vectors
Unit 11	Matrices, Determinants	• Matrix, Types of Matrices, Algebra of Matrices, • Determinants, Inverse of Matrix
Unit 12	Linear Equations, Polynomials	• Linear Equations, System of Linear Equations, Representation in Matrix Form, Cramer's Rule • Polynomials, Operations on Polynomials, Roots of polynomial Equation, Test of Divisibility, Quadratic Equations and their Roots
Unit 13	Introduction to Graph theory	• Graph, Commonly used terminology in Graph Theory, Some important types of Graphs, Representation of Graphs using Matrix, Eulerian and Hamiltonian Graphs
Unit 14	Mensuration	• Areas of Plane Figures, Perimeters of Plane Figures, Volumes of Solid Objects, Surface Areas of Solid Objects

Course details

Course Code	Course	Category	Course Type	Credits
BCAV101	Advanced Excel	VSC	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
14	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

CO1: Apply logical, lookup, text, date-time, and array functions to manipulate and analyze data effectively in Excel.

CO2: Utilize data validation, conditional formatting, error handling, PivotTables, and PivotCharts to summarize, visualize, and present datasets.

CO3: Perform advanced data analysis using Power Query, Power Pivot, and DAX to clean, transform, and model large-scale data.

CO4: Automate tasks and develop interactive dashboards using Macros, VBA scripting, and advanced visualization techniques for decision-making.

CO–PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2			2
CO2	2	3	3			2
CO3	2	3	3		2	2
CO4	2	3	2		2	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

Practical No.	Practical	Activities
1.	Excel Basics & Interface	Perform data entry, apply filled series, use essential keyboard shortcuts, and navigate worksheet elements (rows, columns, ribbons, tabs).
2.	Data Formatting & Cell Referencing	Format a given dataset (borders, colors, alignment), and apply Absolute, Relative, and Mixed referencing in formulas.
3.	Named Ranges & Basic Arithmetic Functions	Create named ranges and use them with arithmetic functions such as SUM, AVERAGE, MAX, MIN.
4.	Statistical & Logical Functions	Use functions such as COUNT, COUNTA, COUNTIF, AVERAGEIF and logical functions like IF, AND, OR, NOT, Nested IF, IFERROR on a dataset.
5.	LOOKUP & VLOOKUP Functions	Apply LOOKUP, VLOOKUP, Nested VLOOKUP, and HLOOKUP to retrieve data from multiple tables.
6.	Advanced Functions (INDEX, MATCH, INDIRECT)	Use INDEX and MATCH to perform advanced lookups and apply INDIRECT to link formulas dynamically.
7.	Data Validation & Dependent Dropdowns	Create single-level and two-level dependent dropdown lists using Data Validation.
8.	Date & Text Function Applications	Use DATE functions (DAY, MONTH, YEAR, EOMONTH, DATEDIF, YEARFRAC) and Text functions (LEFT, RIGHT, MID, SEARCH, PROPER, CONCAT) to clean and transform data.
9.	Data Cleaning & Handling	Remove duplicates, format inconsistent data, and apply sorting and filtering (basic and advanced filter) to organize a dataset.

10.	Conditional Formatting	Apply conditional formatting using highlight rules, color scales, icon sets, and data bars to visually analyze data patterns.
11.	Creating Basic & Advanced Charts	Create various charts: Bar, Column, Pie, Line, Combo, Waterfall, and Gantt chart for visual representation of data.
12.	Pivot Tables & Pivot Charts	Create Pivot Tables with grouping, calculated fields, and generate Pivot Charts. Use Slicers and Timelines for interactivity.
13.	Power Query — Data Cleaning & Transformation	Import data using Power Query, perform cleaning (split columns, remove errors, trim text), and load transformed data into Excel.
14.	Merging & Appending Queries	Use Power Query to merge multiple tables (Join) and append datasets to create a combined master dataset.

Reference Books

1. Greg Harvey — *Excel All-in-One for Dummies*, Wiley
2. Microsoft Official Excel Documentation
3. Michael Alexander & Richard Kusleika — *Excel 2019 Bible*, Wiley
4. John Walkenbach — *Microsoft Excel Step by Step*, Microsoft Press

Online Resources:

- Microsoft Learn — Excel Training https://learn.microsoft.com/training
- ExcelJet (Formulas & Functions) https://exceljet.net
- Excel Exposure — Free Excel course https://excelexposure.com
- YouTube — Microsoft Excel Official Channel

Course details

Course Code	Course	Category	Course Type	Credits
AECL101	Listening and Speaking Skills in English	AEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
7	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes (COs)

CO1: Demonstrate effective listening skills by understanding spoken information, viewpoints, and arguments.

CO2: Apply correct pronunciation, stress, and intonation patterns in spoken English.

CO3: Communicate effectively in everyday situations using appropriate conversational expressions.

CO4: Participate confidently in group discussions using suitable language and interaction strategies.

CO5: Demonstrate interview skills including preparation, presentation, and professional communication.

CO6: Use appropriate language and etiquette for telephonic communication in formal and informal contexts.

CO–PO Mapping Matrix

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1					3
CO2						3
CO3	1					3
CO4	1	1				3
CO5		1				3
CO6						3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Unit Title	Contents / Topics
Unit 1	Listening Skills	Importance of Listening, Listening vs. Hearing, Types of Listening, Note-taking Techniques, Listening & Synthesizing Multiple Viewpoints, Evaluating Arguments & Evidence, Non-verbal Aspects, Barriers to Effective Listening (Physical & People-related), Ten Commandments of Listening.
Unit 2	Spoken English	English Sound System: Vowels, Consonants, Syllables, Stress, Intonation Patterns.
Unit 3	Basic Conversational Skills – I	Speaking Skills for Different Purposes: Greetings & Introductions, Introducing Yourself and Others, Requesting & Responding to Requests, Agreeing & Disagreeing.
Unit 4	Basic Conversational Skills – II	Speaking Skills for Different Purposes: Suggesting, Asking for Information, Seeking & Giving Permissions, Apologizing.
Unit 5	Group Discussion	Participating in a Group Discussion, Language Expressions for GD, Sample GD.
Unit 6	Interview Skills	Types of Interviews, Interview Preparation, Making a Good Impression, Language Expressions for Interview.
Unit 7	Telephonic Communication	Making & Receiving Calls, Putting a Call on Hold, Taking & Leaving Messages, Making Appointments, Asking & Giving Information, Ending a Conversation, Telephonic Etiquettes.

Reference Books:

1. Raymond Murphy — *English Grammar in Use*, Cambridge
2. Liz Hamp-Lyons — *Study Writing*, Cambridge
3. Sanjay Kumar & Pushp Lata — *Communication Skills*, Oxford
4. V. Sasikumar et al. — *A Course in Listening and Speaking*, Cambridge

Online Resources:

- British Council LearnEnglish https://learnenglish.britishcouncil.org
- BBC Learning English https://www.bbc.co.uk/learningenglish
- SWAYAM — Communication Skills courses

Course details

Course Code	Course	Category	Course Type	Credits
VECD101	Introduction to the Constitution of India	VEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8 Units (2 books)	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Syllabus

Book	Unit No.	Unit Title	Contents / Topics
Book 1: The Making of the Indian Constitution	Unit 1	Framing of the Constitution	Objectives, Preface/Introduction, British Colonialism, Background to Constitution-making, Framework of New Constitution, Formation & Inclusive Leadership of Constituent Assembly, Ideological Spectrum, Proceedings, Stages of Constitution-making, Glossary, Self-Study Exercises, Summary, References.
	Unit 2	Sources of the Indian Constitution	Objectives, Preface/Introduction, Influences on the Constitution, Sources of the Constitution, Criticism of the Constitution, Self-Study Exercises, Further Reading.
	Unit 3	Fundamental Duties	Objectives, Preface/Introduction, Background & History, Explanation & Importance, Implementation, Criticism, Relationship with Fundamental Rights, Glossary, Self-Study Exercises, Summary, References.
	Unit 4	Indian System of Governance	Objectives, Preface/Introduction, The President, Rajya Sabha, Lok Sabha, Supreme Court, Procedure for Constitutional Amendments, Glossary, Self-Study Exercises, Summary, References.

Book 2: The Indian Constitution: Our Rights and Duties	Unit 1	Fundamental Rights (Background & Judicial Protection)	Objectives, Preface/Introduction, Background & History, Constitutional Provisions, Importance, Judicial Protection, Glossary, Self-Study Exercises, Summary, References.
	Unit 2	Directive Principles of State Policy (DPSP)	Objectives, Preface/Introduction, Background & History, Features, Classification, Constitutional Amendments, Implementation, Criticism, Conflicts with Fundamental Rights, Glossary, Self-Study Exercises, Summary, References.
	Unit 3	Philosophy of the Indian Constitution (Preamble)	Objectives, Preface/Introduction, "We, the People of India", Liberty, Equality, Fraternity, Justice, Democracy, Secularism, Socialism, Glossary, Self-Study Exercises, Summary, References.
	Unit 4	Features of the Indian Constitution	Objectives, Preface/Introduction, Features of the Constitution, Criticism, Glossary, Self-Study Exercises, Summary, References.

Reference Books:

1. Subhash Kashyap — *Our Constitution*, National Book Trust
2. P. M. Bakshi — *The Constitution of India*, Universal Law Publishing
3. D. D. Basu — *Introduction to the Constitution of India*, LexisNexis
4. M. Laxmikanth — *Indian Polity*, McGraw-Hill

Online Resources:

- National Portal of India — Constitution Text https://www.india.gov.in
- PRS Legislative Research https://prsindia.org
- NCERT Political Science Resources https://ncert.nic.in
- SWAYAM — Constitutional Studies courses

Course details

Course Code	Course	Category	Course Type	Credits
IKSK104	भारतीय ज्ञान परंपरेच्या अनुषंगाने विज्ञान आणि तंत्रज्ञान	IKS	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
11	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes (COs):

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

CO1: Explain the fundamental concepts of Indian Knowledge Systems (IKS) and describe the scientific ideas reflected in Vedas, Vedangas, and ancient Indian literature.

CO2: Describe the contributions of ancient Indian scholars in the fields of astronomy, mathematics, physics, chemistry, agriculture, architecture, and environmental science.

CO3: Analyze traditional Indian scientific knowledge and compare it with modern scientific concepts and developments.

CO4: Interpret the relevance of Indian traditional knowledge systems in present-day sustainable development, environmental conservation, agriculture, and scientific thinking.

CO5: Develop awareness of India's scientific heritage, ethical values, cultural traditions, and interdisciplinary approaches to knowledge and learning.

CO–PO Mapping Matrix

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1					3
CO2	2		1		1	3
CO3	2	1	1		2	3
CO4	1		1		1	3
CO5	1				1	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus:

Unit	Name	Details
1	वेद आणि विज्ञान	• वेद • वेदांचे अध्ययन • वेदांचे वर्गीकरण • वेदांग • वेदांमधील विज्ञान • अन्य आर्ष वैदिक वाङमयात विज्ञान
2	खगोलशास्त्र	• खगोलशास्त्राचा उगम • वेदकालीन खगोलशास्त्र • वेदांग ज्योतिषकालीन खगोलशास्त्र • आधुनिक खगोलशास्त्र • प्राचीनकालीन उपकरणे
3	ज्योतिषशास्त्र	• गणित, दशांक पद्धती • खगोल • त्रिस्कंध ज्योतिष • ज्योतिषाचा उद्देश • कालगणना • गणित व फलित विषय विभाग • अयनगोल विचार
4	स्थापत्यशास्त्र	• स्थापत्यशास्त्र • वास्तुशास्त्र • शास्त्र आधार • जमीन • शिल्पज्ञ व त्यांचे मदतनीस • मोजमाप • मालची निवड • पाया • जमीन परीक्षा (भूमी परीक्षा) • देऊळ • किल्ले • बारव • नगर – व्यवस्थाशास्त्र • नाट्य शास्त्र
5	गणितशास्त्र	• बौधायन • आचार्य पिंगला • आर्यभट

		• आचार्य वराहमिहिर • आचार्य ब्रह्मगुप्त • पहिला भास्कराचार्य • श्रीधराचार्य • महाविराचार्य • दुसरा भास्कराचार्य • माधव (माधवन) • भारतीय गणितशास्त्राच्या वैशिष्ट्यांची माहिती
6	भूगर्भ शास्त्र	• प्रागैतिहासिक काळातील उत्पत्ती • भारतातील भू-पुराणकथा आणि भूगर्भशास्त्र • भारतातील प्राचीन खाण काम • जलमंडल / जलावरण
7	रसायनशास्त्र	• पार्श्वभूमी • ऐतिहासिक माहिती • पारा • जस्त • लोह • विविध भस्मे • आसव
8	भौतिकशास्त्र	• पंच महाभूते • विश्व आणि त्याची निर्मिती (पुराणे आणि वेद) • परस्पर संबंध (ब्रह्म आणि आत्मा) • उर्जा (प्राण) • ध्वनी आणि स्पंदन (नाद) • प्रकाश (तेजस) • प्रकाशाचे प्रतिबिंब आणि अपवर्तन • कणाद यांचा अनुवाद : अणूंचे जग • गति आणि बलांचे सिद्धांत (न्याय सूत्र) • काळ एक बहुआयामी संकल्पना • शून्य आणि अनंताची संकल्पना • तरंग कण द्वैत (तंत्र आणि वेदांत) • उष्मा गतिकी (आयुर्वेदातील उष्णता आणि रुपांतर) • चुंबकत्व आणि वीज (अगस्त्य संहिता) • सूर्य सिद्धांत: खगोलशास्त्रातील एक अद्भुत प्रवास ! • भास्करा चार्याचे गुरुत्वाकर्षण सिद्धांत: न्यूटन पूर्वीच गुरुत्वाकर्षणाचा शोध! • आर्यभट्टाचे खगोलशास्त्रीय योगदान: एका महान ऋषींचे क्रांतिकारी विचार
9	पर्यावरण शास्त्र	• सध्याच्या पार्यावर्निक महासंकटाची कारणे

		• भारतीय तत्त्वज्ञान आणि जीवनविचार • निसर्ग विषयक भाव • निसर्ग हानी • भविष्यासाठी धडे
10	कृषिशास्त्र	• वेदोक्त भारतीय कृषी ज्ञान परंपरा • भारतीय प्राचीन वाङ्मय आणि कृषी • कृषी पराशर आणि काश्यपीयकृषीसुक्ती • सिंधू संस्कृतीमध्ये गहू, कापूस, ऊस लागवड • भारतीय कृषी – प्रारंभिक इतिहास • भारतीय कृषी – मध्य आणि आधुनिक युग • भारतीय कृषी – वसाहती ब्रिटिश युग • प्रजासत्ताक भारत (१९४७ नंतर)
11	वनस्पतीशास्त्र	• प्राचीन भारतातील वनस्पती विज्ञानाचा इतिहास • प्राचीन वनस्पती विज्ञानाचे स्वरूप • वृक्ष – वनस्पतींचे प्रकार व स्वरूप • वृक्षायुर्वेदातील महत्त्वाचे विभाग आणि त्यांचे सविस्तर वर्णन • महाभारतातील वनस्पतींना संवेदना असण्याबाबत विचार • प्राचीन भारतीय सांस्कृतिक दृष्टीकोन • वैज्ञानिक दृष्टीकोन आणि वृक्षायुर्वेद • प्राचीन काळातील वृक्षारोपण पध्दती

Reference Books

1. Mahadevan, B., Vinayak Rajat Bhat & Nagendra Pavana R.N.
   Introduction to Indian Knowledge System: Concepts and Applications, PHI Learning Pvt. Ltd., 2022.
2. Kapil Kapoor & Avadhesh Kumar Singh (Editors)
   Indian Knowledge Systems – Vol. I & II. D.K. Printworld, New Delhi.
3. B.G. Sidharth
   The Celestial Key to the Vedas, Inner Traditions Publications.
4. Subhash Kak & T.R.N. Rao**,** *Computing Science in Ancient India,* Munshiram Manoharlal Publishers.

Online Resources

- Indian Knowledge Systems (IKS) Division – Ministry of Education https://iks.aicte-india.org/
- IKS E-Books and Knowledge Repository https://iks.aicte-india.org/ebook.php
- UGC Guidelines for Incorporating IKS in Higher Education https://snggdcg.ndl.gov.in/items/083a1536-cb8f-4660-ab0b-8a329e521b6b?
- NPTEL Courses on Indian Knowledge Systems https://nptel.ac.in/

IKSK105: Indian Knowledge System – Generic ***(Offered in Online mode)***

CCRX101 to CCRX106: [Practical: 2 Credits]

Semester I						
Course Code	**Course Name**	**Theory/ Practical /Project**	**Total Study (HRS)**	**Credit Points**	**Assessment Type**	**Passing Marks**
CCRX101	Health and Wellness-I	Practical	60	2	CA (20/50)	20/50
CCRX102	Yoga Education-I	Practical	60	2	CA (20/50)	20/50
CCRX103	Sports and Fitness-I	Practical	60	2	CA (20/50)	20/50
CCRX104	Cultural Activities-I	Practical	60	2	CA (20/50)	20/50
CCRX105	NSS-I	Practical	60	2	CA (20/50)	20/50
CCRX106	Fine/Applied/Visual/Performing Arts-I	Practical	60	2	CA (20/50)	20/50

SEMESTER-II

Course details

Course Code	Course	Category	Course Type	Credits
BCAC103	Data Structures using C++	Major (Core)	Theory	4

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
14	12	120	2	30 marks	70 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Apply the principles of Object-Oriented Programming and C++ fundamentals (tokens, datatypes, operators, control structures, functions, and classes) to develop structured and modular programs.

CO2: Implement and manipulate data structures such as arrays, strings, pointers, dynamic memory, and linked lists to solve computational problems.

CO3: Apply stack, queue, recursion, searching, and sorting techniques to perform efficient data processing and problem-solving.

CO4: Analyze and implement advanced data structures and algorithms including trees, heaps, graphs, hashing, and tries to address complex computational problems.

CO–PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3				2
CO2	3	3	2			2
CO3	3	3	2			2
CO4	3	3	2		2	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Title	Details
Unit 1	Introduction to OOP and C++	• Principles of Object-Oriented Programming -Basic Concepts of OOPS, OOP Languages, Pre-processors directives and header files • Structure of C++ program, compiling and linking, Tokens, keywords, identifiers and constants, datatypes, symbolic constants, variables • Storage Classes, operators, manipulators, control and statement loops.
Unit 2	Classes and Objects	• Classes and objects: Specifying a class, member functions, arrays within a class 6 static data members and member functions, arrays of objects, returning objects
Unit 3	Functions in C++	• Functions in C++: Introduction, Main function, function prototype, call by reference, return by reference, Inline functions.
Unit 4	Arrays and Strings	• One-dimensional and multi-dimensional arrays • Operations on arrays (insertion, deletion, searching, sorting) • String operations and manipulation
Unit 5	Pointers and Dynamic Memory Allocation	• Understanding pointers and pointer arithmetic • Dynamic memory allocation (new, delete) • Pointers with arrays and functions
Unit 6	Linked Lists	• Introduction to Singly Linked List • Insertion, Deletion, and Traversal in Linked Lists • Doubly Linked List and Circular Linked List • Applications of linked lists
Unit 7	Stacks & Queues	• Introduction to Stack (LIFO) • Stack implementation using arrays and linked lists • Applications: Expression evaluation (Infix to Postfix, Prefix), Balanced Parentheses • Queue (FIFO) implementation using arrays and linked lists • Circular Queue and Deque (Double-Ended Queue) • Priority Queue and its applications
Unit 8	Recursion and Backtracking	• Understanding recursion and its execution • Tail and non-tail recursion • Backtracking concepts
Unit 9	Searching and Sorting Algorithms	• Searching: Linear Search, Binary Search • Sorting: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort • Comparison of different sorting techniques
Unit 10	Trees and Binary Search Trees (BST)	• Introduction to Trees and Tree Traversal (Preorder, Inorder, Postorder) • Binary Trees and Binary Search Trees (BST) • BST Operations (Insertion, Deletion, Searching) • AVL Trees and Self-Balancing Trees

Unit 11	Heaps and Priority Queues	• Introduction to Heaps (Min-Heap, Max-Heap) • Heap operations (Insertion, Deletion) • Heap Sort Algorithm • Applications of Heaps in Priority Queues
Unit 12	Graphs and Graph Algorithms	• Graph representation (Adjacency Matrix & Adjacency List) • Graph Traversals: BFS (Breadth-First Search) & DFS (Depth-First Search) • Shortest Path Algorithms (Dijkstra's and Floyd-Warshall) • Minimum Spanning Trees (Prim’s and Kruskal’s Algorithm)
Unit 13	Hashing and Hash Tables	• Introduction to Hashing and Hash Functions • Collision Resolution Techniques: Chaining, Open Addressing (Linear, Quadratic Probing, Double Hashing) • Applications of Hash Tables
Unit 14	Advanced Data Structures (Tree, Segment Tree, Red-Black Tree)	• Tree (Prefix Tree) and its applications • Segment Tree for range-based queries • Red-Black Trees and their balancing properties

Course details

Course Code	Course	Category	Course Type	Credits
BCAC104	Web Technology	Major (Core)	Theory	4

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
16	12	120	2	30 marks	70 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain fundamental web concepts, web architecture, and different generations of web technologies.

CO2: Design and develop static web pages using HTML elements, formatting tags, forms, and multimedia components.

CO3: Apply CSS concepts including selectors, box model, and layout techniques to enhance website presentation and usability.

CO4: Develop interactive and dynamic web pages using JavaScript, DHTML, and DOM manipulation techniques.

CO5: Demonstrate understanding of web hosting, publishing processes, and deployment of websites on web servers.

CO6: Create structured XML documents and apply basic website design principles to build user-friendly and efficient websites.

CO–PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1		2	1	2
CO2	2	3				2
CO3	1	3				2
CO4	2	3		1	1	2
CO5	2	2		3		2
CO6	2	3	1		1	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Title	Details
Unit 1	Introduction to Internet and World Wide Web	Evolution of Internet and World Wide Web, Difference between Internet and WWW, Web 1.0, Web 2.0 and Web 3.0
Unit 2	Web Architecture and Web Applications	Client–Server Architecture, Web Browsers and Web Servers, Types of Web Applications
Unit 3	Web Development Process	Overview of Web Development, Web Development Life Cycle (WDLC), Requirement Analysis, Website Planning, Website Architecture, Development Phases, Testing, Deployment and Maintenance
Unit 4	Web Publishing and Hosting	Web Publishing Concepts, Domain Names and Domain Registration, DNS, Types of Web Hosting, Web Servers (Apache, IIS – overview), FTP, Website Deployment
Unit 5	Web Content Management	Web Content Definition, Types of Web Content, Static Web Content, Dynamic Web Content, Role of Databases, Multimedia Content, Content Optimization
Unit 6	Web Technologies for Browsers	HTML, DHTML, XHTML, JavaScript, JSP – Introduction, Features of Web Technologies, Applications of Web Technologies
Unit 7	Introduction to HTML	HTML Fundamentals, Features of HTML, HTML Editors and Tools, HTML Browsers, HTML Tags, Elements and Attributes, Structure of HTML Document (Head and Body)
Unit 8	HTML Lists and Text Formatting	Ordered, Unordered and Definition Lists, Nested Lists, Block Level Tags, Headings, Paragraphs, Text Alignment, Font Size, Comments, Text Level Tags (Bold, Italic, Underline, Strikethrough, Subscript, Superscript)
Unit 9	HTML Images, Forms and Frames	Inserting Images, Image Attributes and Scaling, Image Mapping (Basic), Forms and Form Controls, Frames and Frameset Concepts, Advantages and Limitations, Introduction to DOM
Unit 10	Dynamic HTML (DHTML)	Introduction to DHTML, Components of DHTML (HTML, CSS, JavaScript, DOM), Dynamic Content Creation, Dynamic Style Manipulation, Event-driven Web Pages
Unit 11	Cascading Style Sheets	Need and Importance of CSS, Advantages of CSS, Types of Style Sheets (Inline, Internal, External), Creating and Linking CSS, CSS Syntax, Common CSS Tasks
Unit 12	Advanced CSS Concepts	CSS Selectors, CSS Properties, Font Family and Font Metrics, CSS Units (px, em, rem, %, vh, vw), CSS Classes and IDs, Pseudo Classes and Pseudo Elements, CSS Box Model

Unit 13	Client-Side Scripting	Introduction to Scripting Languages, Characteristics of Scripting Languages, Client-side vs Server-side Scripting, Types of Scripting Languages, Role of JavaScript
Unit 14	JavaScript Fundamentals	JavaScript Basics, Syntax, Variables and Data Types, Operators, Assignments and Comparisons, Reserved Words, Functions
Unit 15	JavaScript Control Statements, Objects and Event Handling	Conditional and Looping Statements, Objects (Date, Math, String, Event, Frame, Screen), Event Handling, Keyboard and Mouse Events
Unit 16	XML and Website Design Concepts	Introduction to XML, Features of XML, XML vs HTML, Anatomy of XML Document, Creating XML Documents, XML DTD, XML Schema, XSL, Website Design Principles, Types of Websites, Revision

Course details

Course Code	Course	Category	Course Type	Credits
BCAC105	Operating System	Major (Core)	Theory	4

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
14	12	120	2	30 marks	70 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain the evolution, types, and structure of operating systems along with their services such as process, memory, and file management.

CO2: Apply concepts of processes, threads, scheduling, and inter-process communication (IPC) to analyze and solve synchronization problems.

CO3: Demonstrate understanding of deadlock handling, memory management techniques (contiguous, non-contiguous, virtual memory), and device management.

CO4: Analyze operating system security mechanisms, protection policies, authentication methods, and evaluate modern OS features and applications.

CO–PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	1	2
CO2	2	3	2	3	2	2
CO3	2	2	3	3	2	2
CO4	2	2	2	2	3	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit No.	Title	Details
Unit 1	History of the Operating Systems	• Introduction (What is OS, Importance of OS, Features, Uses, Applications) • Evolution of OS (proprietary, CP/M, DOS, UNIX, Windows and other, Command line to GUI, Portability, Client Server)
Unit 2	Types of Operating System	• Types of Operating System (multiprogramming systems, batch systems, time sharing systems; operating systems for personal computers & workstations, process control & real time systems.) • User's View of the Operating System

Unit 3	Operating System Functions	• Different Services of the Operating Systems
		  ○ Information Management
		  ○ Process Management
		  ○ Memory Management
		• Uses of System Calls

Unit 4	Operating System Structure	• Operating System Structure (Monolithic (Simple) Operating System, Layered Operating System, Microkernel Operating System, Exokernel Operating system), • Virtual Machine • Booting
Unit 5	Information Management	• Disk Basics • Direct Memory Access (DMA) • File System (Block and Block numbering Scheme, File Support Levels, Writing/Reading a Record
Unit 6	Device Driver	• Relationship between the Operating System and DMS, File Directory Entry, Open/Close Operations, Disk Space Allocation Methods, Directory Structure: User's View, Implementation of a Directory System) • Device Driver (DD) (Basics, Path Management, Submodules of DD
Unit 7	Process Management	• Process, • Evolution of Multiprogramming • Context Switching, • Process States, Process State Transitions, Process Control Block (PCB), Process Hierarchy, Operation on a Process, Create/ Kill/ Dispatch a Process, Change the Priority of a Process
Unit 8	Process Scheduling	• Block / Time Up /Wake Up a Process, Suspend/ Resume Operations, • Process Scheduling (Objectives, Concepts of Priority and Time Slice, Scheduling philosophies, Scheduling Levels, Scheduling Policies (For Short Term scheduling)), • Multithreading (Models, Implementation of Threads)
Unit 9	Inter Process Communication	• The Producer-Consumer Problems, Solutions to the Producer-Consumer Problems (Interrupt Disabling/Enabling, Lock-flag, • What are Primitives for Mutual Exclusion? • Classical IPC problems • Semaphores • Alternating Policy • Peterson's Algorithm

Unit 10	I/O Management and Deadlock	• I/O Procedure, I/O Scheduler, Device Handler, Interrupt Service Routine (ISR) • Terminal I/O (Terminal Hardware, Terminal Software) • Organizing Data on the CD-ROM, DVD-ROM • Graphical Representation of a Deadlock, • Deadlock Prerequisites • Deadlock Strategies (Ignore a Deadlock, Detect a Deadlock, Recover from a Deadlock, Prevent a Deadlock, Avoid a Deadlock)
Unit 11	Memory Management	• Single Contiguous Memory Management • Fixed Partitioned Memory Management • Variable Partitions (Allocation Algorithms, Swapping, Relocation and Address Translation, Protection and Sharing, Evaluation)
Unit 12	Non-Contiguous Allocation	• Non-Contiguous Allocation – General Concepts, Paging (Allocation Algorithms, Swapping, Relocation and Address Translation), Segmentation (Swapping, Address Translation and Relocation, Sharing and Protection) • Combined Systems
Unit 13	Virtual Memory	• Virtual Memory Management Systems (Relocation and Address Translation, Swapping, Relocation and Address Translation, Protection and Sharing, • Evaluation, Design Consideration for Virtual Systems)
Unit 14	Protection and Security	• Protection and Security Policy mechanism • Authentication • Internal access Authorization

Course details

Course Code	Course	Category	Course Type	Credits
BCAS102	Lab on Data Structures using C++	SEC	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
14	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

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

CO1: Apply C++ programming constructs including input/output operations, functions, arrays, strings, and pointers to solve basic computational problems.

CO2: Implement fundamental linear data structures such as linked lists, stacks, and queues, and apply them to solve expression evaluation and other practical problems.

CO3: Develop recursive and iterative solutions for searching, sorting, backtracking, and tree-based problems, analyzing their time and space complexities.

CO4: Apply advanced data structures (heaps, graphs, hashing, tries, balanced trees) and integrate them into real-life projects using C++.

CO–PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	1	1	2
CO2	3	3	1	1	1	2
CO3	3	3	2	1	2	3
CO4	3	3	2	2	2	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

Unit No.	Title	Details
Unit 1	Introduction to Data Structures and Algorithms Arrays and Strings	1. Write a C++ program to analyse time complexity of nested loops. 2. Implement basic input/output operations and simple functions. 3. Implement array operations (Insert, Delete, Search, Sort). 4. Reverse a string using a character array. 5. Check if a string is a palindrome.
Unit 2	Pointers and Dynamic Memory Allocation Linked Lists Stacks and Applications	1. Create a dynamic array using pointers. 2. Implement a function to swap two numbers using pointers. 3. Use a pointer to traverse an array. 4. Implement a singly linked list with insert and delete operations. 5. Convert a linked list into a doubly linked list. 6. Implement a stack using an array. 7. Convert an infix expression to postfix and evaluate it using a stack.
Unit 3	Queues and Variants Recursion and Backtracking Searching and Sorting Algorithms	1. Implement a simple queue using an array. 2. Implement a circular queue. 3. Implement recursive factorial and Fibonacci functions. 4. Solve the N-Queens problem using backtracking. 5. Implement binary search in a sorted array. 6. Compare sorting algorithms by measuring execution time.
Unit 4	Trees and Binary Search Trees (BST) Heaps and Priority Queues	1. Implement a BST with insertion and deletion. 2. Perform Inorder, Preorder, and Postorder traversals. 3. Implement a Min-Heap using an array. 4. Implement Heap Sort.
Unit 5	Graphs and Graph Algorithms Hashing and Hash Tables	1. Implement Graph Traversal using BFS and DFS. 2. Find the shortest path using Dijkstra's Algorithm. 3. Implement a hash table using separate chaining. 4. Solve a problem using hashing (e.g., anagram detection).
Unit 6	Advanced Data Structures (Tree, Segment Tree, Red-Black Tree) Final Project and Real-World Applications	1. Implement a Tree for auto-complete. 2. Implement a Red-Black Tree for balanced insertion. 3. Choose a project (e.g., job scheduling system, social network graph). 4. Implement the chosen project using C++ data structures.

Course details

Course Code	Course	Category	Course Type	Credits
BCAV102	Lab on Web Technology	VSC	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
14	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

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

CO1: Develop and host static web pages using HTML, CSS, and JavaScript with responsive design and interactive features.

CO2: Apply advanced frontend techniques including API integration, Bootstrap/Tailwind frameworks, accessibility, SEO optimization, and performance improvements.

CO3: Build backend applications using Node.js, Express.js, and databases (MySQL/MongoDB) to implement secure CRUD operations and authentication.

CO4: Demonstrate version control, deployment, and DevOps practices using Git, GitHub, cloud platforms, and CI/CD pipelines.

CO–PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	2
CO2	2	3	2	2	3	2
CO3	2	3	3	3	3	2
CO4	2	3	2	2	2	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

No.	Title
1)	Design an HTML Web Page to Demonstrate Different Types of Lists: a. Unordered List b. Ordered List c. Definition List d. Nested List
2)	Design an HTML Web Page to Demonstrate Hyperlinks: a. Navigation between Web Pages b. Navigation within a Web Page
3)	Design an HTML Web Page to Create a Time-Table Using Tables.
4)	Design a Static Home Page Using HTML Frames.
5)	Design a Static Registration Form Using HTML Form Elements.
6)	Design a Static Login Page Using HTML.
7)	Design a Static Menu Catalogue Web Page Using HTML.
8)	Design a Static Shopping Cart Web Page Using HTML.
9)	Design an HTML Web Page to Demonstrate Cascading Style Sheets (CSS): a. Inline CSS b. Internal (Embedded) CSS c. External CSS
10)	Develop a JavaScript Program to Validate a User Login Page.
11)	Develop a JavaScript Program to Validate a Registration Form.
12)	Create an XML Document to Represent Customer Details.
13)	Create an XML Document with an Internal Document Type Definition (DTD) to Validate Customer Details.
14)	Create an XML Document with an External Document Type Definition (DTD) to Validate Customer Details.

Course details

Course Code	Course	Category	Course Type	Credits
AECL102	Reading and Writing Skills in English	AEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
12 (2 books)	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Demonstrate improved vocabulary and reading comprehension skills for academic and professional contexts.

CO2: Apply appropriate reading strategies such as skimming, scanning, and intensive reading for different purposes.

CO3: Interpret information presented in tables, diagrams, and graphs effectively.

CO4: Construct grammatically correct sentences and coherent paragraphs using proper language conventions.

CO5: Develop structured written communication including essays, letters, reports, and resumes.

CO6: Apply appropriate formats and etiquette for email writing and social media communication.

CO–PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1					3
CO2	1		1			3
CO3	1		2		1	2
CO4		1				3
CO5		1	1			3
CO6		1		1		3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

BOOK 01. DEVELOP YOUR READING SKILLS

Unit	Title	Details
Unit 1	Improving Vocabulary	Objectives, Introduction, Words as 'Power', Functional Vocabulary, Word and Sense, Types of Meaning, Formation of Words, Synonyms and Antonyms (Synonyms, Antonyms), Prefixes and Suffixes (Prefixes, Suffixes), Lexical Webs, Collocations, Idioms, Use of Dictionary and Thesaurus, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Resources for Building Vocabulary, Suggested Reading
Unit 2	Reading Comprehension	Objectives, Introduction, Reading Skills, Reading and Understanding, Bad Reading Habits, Levels of Reading Comprehension, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Sources for Reading Skills, Suggested Reading
Unit 3	Types of Reading	Objectives, Introduction, Types of Reading, Skimming, Scanning, Intensive Reading, Extensive Reading, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading
Unit 4	Reading Speed	Objectives, Introduction, Reading Speed, Eye Span and Eye-Fixation, Methods to Increase Reading Speed, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading
Unit 5	Reading for Different Purposes	Objectives, Introduction, Reading Newspapers, Reading Textbooks, Tips for Reading Textbooks, SQ3R Technique of Reading, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading
Unit 6	Reading Tables, Diagrams, and Graphs	Objectives, Introduction, Reading Diagrams and Graphs, Reading Data from Tables, Reading Diagrams, Bar Graphs, Histogram, Pie Chart, Tree Diagrams, Guidelines for Reading Diagrams, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading

BOOK 02. DEVELOP YOUR WRITING SKILLS IN ENGLISH

Unit	Title	Details
Unit 1	Sentence Construction and Transformation	Objectives, Introduction, Sentence Construction and Transformation, Basic Sentence Patterns, Subject–Verb Concord, Tenses, Modal Auxiliaries, Active and Passive Constructions, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Sources for Learning Grammar, Suggested Readings
Unit 2	Paragraph Writing	Objectives, Paragraph Writing, Kinds of Sentences Used in a Paragraph, Structure of a Good Paragraph, Types of Paragraphs, Transitional Words or Phrases, Step-by-Step Guide to Write a Paragraph, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading
Unit 3	Essay Writing	Objectives, Essay Writing, Types of Essays, Characteristics of a Good Essay, Structure of a Good Essay, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Suggested Reading
Unit 4	Letter Writing	Objectives, Introduction, Letter Writing, Formal Letters, Informal Letters, Application Letter, Resume Writing, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Resources for Letter and Resume Writing, Suggested Reading
Unit 5	Report Writing	Objectives, Introduction, Report Writing, Types of Reports, Newspaper Report, Investigative Report, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Resources for Letter and Resume Writing, Suggested Readings

Unit 6	Email Writing and Writing for Social Media	Objectives, Introduction, Email Writing, Guidelines for Writing a Good Email, Format of an Email, Email Etiquettes, Writing for Social Media, Social Media Concepts, Social Networking Sites and Apps, Writing for Facebook, Twitter and WhatsApp, Use of Emoji, Social Media Etiquettes, Let Us Sum Up, Glossary, Answers to Check Your Progress, Questions for Practice, Online Sources, Suggested Reading

Reference Books

1. Raymond Murphy — *English Grammar in Use*, Cambridge
2. Oxford Guide to Effective Writing & Speaking
3. Sanjay Kumar & Pushp Lata — *Communication Skills*, Oxford
4. Liz Hamp-Lyons & Ben Heasley — *Study Writing*, Cambridge

Online Resources

- British Council — Writing & Reading Skills https://learnenglish.britishcouncil.org
- Purdue OWL — Academic Writing https://owl.purdue.edu
- BBC Learning English — Vocabulary & Grammar

Course details

Course Code	Course	Category	Course Type	Credits
VECD102	Environmental Education	VEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain the relationship between humans and the environment and the impact of development on ecological systems.

CO2: Identify various natural resources and analyze their utilization and conservation.

CO3: Describe sustainable development concepts and global initiatives such as the SDGs.

CO4: Explain biodiversity, ecosystems, and conservation strategies to protect environmental balance.

CO5: Analyze different types of environmental pollution and their effects on human health and ecosystems.

CO6: Describe environmental management practices, policies, treaties, and legislation for environmental protection.

CO–PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1					3
CO2	1		1			3
CO3	1				1	3
CO4	1					3
CO5	1			1		3
CO6	1			1		3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details
Unit 1	Humans and the Environment	The man-environment interaction: Humans as hunter-gatherers; India's knowledge and culture of sustainability; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change; UN Conference on Human Environment 1972; World Commission on Environment and Development.
Unit 2	Natural Resources	Definition; Types of natural resources; Forest resources; Water resources; Soil and Mineral resources; Energy resources;
Unit 3	Introduction to Sustainable Development	Sustainable Development Goals (SDGs) - targets and indicators; Challenges and strategies for SDGs.
Unit 4	Conservation of Biodiversity and Ecosystems	Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Ecosystems & their services; Threats to biodiversity and ecosystems; Biodiversity conservation practices- in-situ and ex-situ conservation approaches.
Unit 5	Environmental Pollution and Health - I	Pollution; Definition of pollution; Point sources and non-point sources of pollution; Air pollution (Sources; Criteria pollutants; Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards.) Water pollution (Sources; Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.)
Unit 6	Environmental Pollution and Health – II	Soil pollution (Soil pollutants and their sources); Solid and hazardous waste (Sources and Impact on human health); Noise pollution (Definition; Sources; Noise standards; adverse impacts of noise on human health); Thermal and Radioactive pollution (Sources; impact on human health and ecosystems)
Unit 7	Environmental Management	Constitutional provisions- Article 48A, Article 51A (g); Environmental management system: ISO 14001; Life cycle analysis; Environmental audit and impact assessment; Concept of 3R (Reduce, Recycle and Reuse); Ecolabeling /Ecomark scheme.
Unit 8	Environmental Treaties and Legislation	i) Major Indian Environmental Legislations: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; Noise Pollution (Regulation and Control) Rules, 2000; Waste management rules; Ramsar sites; ii) Major International Organizations and Initiatives: United Nations Environment Programme (UNEP); International Union for Conservation of Nature (IUCN); United Nations Educational, Scientific and Cultural Organization (UNESCO); Intergovernmental Panel on Climate Change (IPCC).

Reference Books

1. V. K. Ahluwalia — *Environmental Studies*, TERI Press
2. R. Rajagopalan — *Environmental Studies: From Crisis to Cure*, Oxford
3. Erach Bharucha — *Textbook of Environmental Studies for Undergraduate Courses*, UGC / Universities Press
4. Benny Joseph — *Environmental Studies*, McGraw-Hill

Online Resources

- UNEP Resources https://www.unep.org
- UNESCO Environmental Education https://www.unesco.org
- IGNOU Environmental Studies Materials https://egyankosh.ac.in
- SWAYAM — Environmental Studies courses

CCRX107 to CCRX112: [Practical: 2 Credits]

Semester II						
Course Code	**Course Name**	**Theory/ Practical /Project**	**Total Study (HRS)**	**Credit Points**	**Assessment Type**	**Passing Marks**
CCRX107	Health and Wellness-II	Practical	60	2	CA (20/50)	20/50
CCRX108	Yoga Education-II	Practical	60	2	CA (20/50)	20/50
CCRX109	Sports and Fitness-II	Practical	60	2	CA (20/50)	20/50
CCRX110	Cultural Activities-II	Practical	60	2	CA (20/50)	20/50
CCRX111	NSS-II	Practical	60	2	CA (20/50)	20/50
CCRX112	Fine/Applied/Visual/Performing Arts-II	Practical	60	2	CA (20/50)	20/50

SEMESTER III

Course details

Course Code	Course	Category	Course Type	Credits
BCAC241	Database Management Systems	Major (Core)	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Understand the fundamentals of database systems, database models, architectures, and data abstraction concepts.

CO2: Design database schemas using ER modeling, relational models, keys, and normalization principles to ensure data integrity.

CO3: Apply SQL commands and relational algebra operations to create, manipulate, and query databases efficiently.

CO4: Analyze advanced database concepts including transactions, concurrency control, recovery techniques, indexing, and distributed databases.

CO5: Evaluate modern database technologies such as NoSQL, database security mechanisms, and emerging trends in DBMS.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	–	1	1
CO2	2	1	3	–	1	1
CO3	1	3	3	–	1	1
CO4	2	2	3	1	1	1
CO5	1	1	2	2	3	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details
Unit 1	Introduction to Database Systems	• Definition and importance of DBMS • File-based system vs. database approach • Characteristics of databases • Database users and architecture • Data independence and data abstraction
Unit 2	Database Models and ER Model	• Overview of hierarchical, network, relational and object-oriented models • Entities, attributes and relationships • ER diagrams and notations • Mapping ER model to relational schema
Unit 3	Relational Model, Algebra and Database Design	• Tables, tuples, attributes and domains • Primary, foreign, candidate and super keys • Basic relational algebra: selection, projection, union, intersection, difference and join • Functional dependencies • Database normalization: 1NF, 2NF, 3NF, BCNF, 4NF and 5NF
Unit 4	SQL – Fundamentals	• SQL syntax and structure • Data Definition Language (DDL) and Data Manipulation Language (DML) • Creating and modifying tables • INSERT, UPDATE and DELETE • SELECT, WHERE and ORDER BY • Aggregate functions, GROUP BY and HAVING
Unit 5	Advanced SQL	• Joins: INNER, OUTER, SELF and CROSS • Subqueries and nested queries • Views, • Basic indexes • Introduction to transactions and transaction commands

Unit 6	Transactions, Concurrency and Recovery	• ACID properties • Transactions and schedules • Basic concurrency control • Locking concepts • Database failures • Backup and recovery concepts
Unit 7	Database Security and Modern Databases	• Database security threats • Authentication and authorization • GRANT and REVOKE • Role-based access control (RBAC) • Introduction to NoSQL databases • SQL vs. NoSQL
Unit 8	Database Administration and Emerging Trends	• Basic indexing concepts and B-Tree/B+ Tree overview • Basic concepts of distributed databases • Cloud databases and Database-as-a-Service (DBaaS) • Introduction to modern database applications and trends

Reference Books

1. C. J. Date — *An Introduction to Database Systems*, Pearson
2. Ramez Elmasri — *Database Systems Models, Languages & Design*
3. Hector Garcia-Molina et al. — *Database Systems: The Complete Book*, Pearson
4. MongoDB Documentation — NoSQL databases
5. Korth, Silberschatz & Sudarshan — *Database System Concepts*, McGraw-Hill
6. Elmasri & Navathe — *Fundamentals of Database Systems*, Pearson
7. Raghu Ramakrishnan & Johannes Gehrke — *Database Management Systems*, McGraw-Hill

Online Resources:

- **SWAYAM / NPTEL — Database Management Systems https://swayam.gov.in https://nptel.ac.in**
- National Digital Library of India (NDLI) https://ndl.iitkgp.ac.in

Global Free Resources

- MIT OpenCourseWare — Database Systems https://ocw.mit.edu
- Stanford DB Course Materials (public lectures available online)

Tutorials & Documentation

- GeeksforGeeks — DBMS Tutorials https://www.geeksforgeeks.org
- TutorialsPoint — DBMS https://www.tutorialspoint.com
- W3Schools — SQL Tutorial https://www.w3schools.com/sql
- PostgreSQL Documentation https://www.postgresql.org/docs

Course details

Course Code	Course	Category	Course Type	Credits
BCAV201	Lab on Database Management Systems	VSC	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
12	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

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

CO1: Install and configure database management systems and create databases.

CO2: Design ER diagrams and convert them into relational schemas.

CO3: Write SQL queries for data definition, manipulation, and retrieval.

CO4: Implement advanced database operations including joins, views, procedures, and normalization.

CO5: Apply transaction management, indexing, backup, and recovery techniques.

CO6: Use distributed, NoSQL, and cloud databases while ensuring security and authorization.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	1	2
CO2	3	2	3			2
CO3	2	3	3			2
CO4	2	3	3	1	1	2
CO5	2	2	3	3		2
CO6	2	2	3	3	2	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

Practical No.	Unit Name	Activities
1	Introduction to Database Systems	Introduction to DBMS software (MySQL, PostgreSQL, Oracle, MongoDB); setting up database environment; creating and managing databases; understanding database concepts and architecture
2	Database Models and Architecture	Understanding different database models; implementing hierarchical, network, and relational models; exploring three-tier architecture
3	Entity-Relationship (ER) Model	Designing ER diagrams using tools (MySQL Workbench, Lucidchart); mapping ER models to relational schema; case study: ER modelling for a library system
4	Relational Model and Algebra	Understanding relational tables, attributes, tuples; implementing relational algebra operations (selection, projection, joins, union, intersection, difference)
5	SQL – Basics	Writing SQL queries (SELECT, INSERT, UPDATE, DELETE); filtering using WHERE, ORDER BY, GROUP BY, HAVING; using aggregate functions (COUNT, SUM, AVG, MAX, MIN)
6	Advanced SQL Concepts	Implementing joins (INNER, OUTER, SELF, CROSS); working with subqueries; creating views, indexes, and stored procedures
7	Normalization and Database Design	Identifying functional dependencies; normalizing tables up to BCNF; designing efficient database schema
8	Transactions and Concurrency Control	Implementing ACID properties; using transaction commands (COMMIT, ROLLBACK, SAVEPOINT); exploring locking mechanisms
9	Database Recovery Techniques	Implementing backup and restore; understanding log-based recovery and shadow paging; simulating crash recovery scenarios
10	Indexing and Hashing	Creating indexes; implementing B-Tree and hash indexing; performance analysis of indexed vs non-indexed queries
11	Distributed	Introduction to distributed DB concepts; implementing

	Databases	fragmentation, replication, allocation; case study on distributed databases
12	Database Security and Authorization	Implementing user authentication; using GRANT and REVOKE; encrypting database data

Reference Books

1. C. J. Date — *An Introduction to Database Systems*, Pearson
2. Peter Rob & Carlos Coronel — *Database Systems: Design, Implementation & Management*, Cengage
3. SQL Complete Reference — James R. Groff & Paul N. Weinberg
4. Elmasri & Navathe — *Fundamentals of Database Systems*, Pearson
5. Korth, Silberschatz & Sudarshan — *Database System Concepts*, McGraw-Hill
6. Ramakrishnan & Gehrke — *Database Management Systems*, McGraw-Hill

Online Resources

- NPTEL — Database Management Systems https://nptel.ac.in
- SWAYAM — DBMS Courses https://swayam.gov.in
- National Digital Library of India (NDLI) https://ndl.iitkgp.ac.in

Course details

Course Code	Course	Category	Course Type	Credits
BCAC204	Data Science and IKS	Major (Core)	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
7	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain the foundations of Indian Knowledge Systems and their relevance to modern data science.
CO2: Relate traditional methods of data collection, classification, and modelling to contemporary practices.
CO3: Analyze ancient analytical approaches in areas such as wellness, climate, behavior, and statistics.
CO4: Evaluate data quality, validation methods, visualization concepts, and ethical considerations from IKS perspectives.
CO5: Interpret traditional concepts related to big data, artificial intelligence, and computational thinking.
CO6: Apply principles from linguistics, encryption, and ancient number systems to modern data representation and NLP.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2		1	3
CO2	2	1	3		1	2
CO3	2		3		2	2
CO4	1	1	3	1	2	3
CO5	2	1	2		3	2
CO6	2	2	2	3	3	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus:

Unit	Title	Details
Unit 1	Introduction to Indian Knowledge Systems	• Vedic Manuscripts and Modern Databases • Ancient Analytical Methods and Modern Data Science • Wisdom through the Ages • Knowledge Framework and Classifications
Unit 2	Data Collection	• Pratyaksha and Data Collection • Data Classification — Business Intelligence / Kautilya's Arthashastra • Data Structuring — Sutras and Data Structuring • Data Modelling — Samkhya Philosophy and Data Modeling
Unit 3	Data Analysis	• Patanjali's Yoga Sutras, Wellness and Psychological Data Analysis • Time-Series and Climate Analytics • Bharata's • Natyashastra and Behavioral Data Analysis • Ganita and Statistical Analysis • Data Mining • The Vedic Corpus
Unit 4	Data Quality	• Dashavidha Pariksha and Data Quality • Data Validation — Pramana and Data Validation • Data Visualization — Yantras and Data Visualization Tools • Chakshu • Ethics and Data Privacy
Unit 5	Big Data	• Traditional Analysis and Big Data Analytics • Yugas and Big Data Epochs
Unit 6	Artificial Intelligence	• Algorithms and Vedic Mathematics • Machine Learning and Vedic Mathematics • Number Systems and Units of Measurement • Astronomy
Unit 7	Data Encryption and NLP	• Data Encryption & Indexing — Katapayadi Hashing • Data Representation — Pingala's Binary System • Predictive Modelling — Arthashastra / Nyaya Inference / Comparison of ancient ontologies (Nyaya–Vaisheshika categories) with modern knowledge graphs • NLP — Panini's Grammar and Data Representation • Linguistics • Chandas and Text Analytics

Reference Books

1. Subhash Kak — *The Astronomical Code of the Rigveda*
2. Michel Danino — *Indian Science and Technology in Ancient India*
3. Kautilya — *Arthashastra* (relevant sections on administration & intelligence)
4. B. K. Matilal — *Perception: An Essay on Classical Indian Theories of Knowledge*
5. S. Balachandra Rao — *Indian Mathematics and Astronomy*
6. B. Mahadevan, Vinayak Rajat Bhat & Nagendra Pavana R. N. — *Introduction to Indian Knowledge System*, PHI Learning
7. Kapil Kapoor & Michel Danino — *Indian Knowledge Systems: Knowledge Traditions and Practices*, DK Printworld
8. S. Kak & R. N. Iyengar — *Indian Knowledge Systems: Concepts and Applications*, Springer

Recommended Open Educational Resources (OER)

- IKS Division, Ministry of Education (IKS Portal) https://iksindia.org
- SWAYAM — IKS Courses https://swayam.gov.in
- NPTEL — Indian Knowledge Systems Courses https://nptel.ac.in
- National Digital Library of India (NDLI) https://ndl.iitkgp.ac.in

Course details

Course Code	Course	Category	Course Type
CSC101	Cyber Security	AUDIT	Theory

(Will be offered ONLINE) (Link: https://cs.ycmouonline.ac.in/)

Course details

Course Code	Course	Category	Course Type	Credits
MATE104	Statistics for Research	OE	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Link of SLM: MATE104 Statistics for Research

Course details

Course Code	Course	Category	Course Type	Credits
XXXE201	Select from **other faculty OE courses list**	OE	Theory	2

Link: https://drive.google.com/drive/folders/1wQTdouKXZBzG7bHWhTR0dqd5NnwGFrmK

Course details

Course Code	Course	Category	Course Type	Credits
BCAF204	Field Project	Field Project	Field Project	2

Note: Guidelines regarding Field Project will be communicated separately.

Course details

Course Code	Course	Category	Course Type	Credits
AECL201	Aadhunik Marathi Bhasha Abhyas - I	AEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8 (2 books)	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Syllabus:

पुस्तक १. मराठी भाषा अभ्यास –I

घटक १. असे होते आपले छत्रपती शाहू महाराज : प्रा. नंदकुमार मोरे

घटक २. डोंगरीवरची शाळा : गो. ना. मुनघाटे

घटक ३. गावची सत्ता महिलांच्या हाती : चंद्रकांत वानखेडे

घटक ४. पुत्रवती भव : जयंत नारळीकर

पुस्तक २. मराठी भाषा अभ्यास –II

घटक १. स्मशानातील सोनं : अण्णाभाऊ साठे

घटक २. दामिनच्या पायथ्याशी : बसुदेव बेसरा (भाषांतर– अरविंद सुरवाडे)

घटक ३. थेरबन : राजा ढाले

घटक ४. आंबेडकरांची पहिली भेट : डॉ. सविता आंबेडकर

Course details

Course Code	Course	Category	Course Type	Credits
AECL203	Aadhunik Hindi Bhasha Ka Adhyayan – I	AEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8 (2 books)	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Syllabus:

पुस्तक 1 : कहानी और हिंदी भाषा का अध्ययन

इकाई 1. पूस की रात : प्रेमचंद

इकाई 2. सपना : ओमप्रकाश वाल्मीकि

इकाई 3. ठिठुरता हुआ गणतंत्र : हरिशंकर परसाई

इकाई 4. फैसला : मैत्रेयी पुष्पा

पुस्तक 2. गद्य साहित्य और हिंदी भाषा का अध्ययन- I

इकाई 1. यज्ञ : महात्मा गांधी

इकाई 2. हेमंत की संध्या : कुबेरनाथ राय

इकाई 3. निराला भाई : महादेवी वर्मा

इकाई 4. मेमोरेंडम : जयंत नारळीकर

Course details

Course Code	Course	Category	Course Type	Credits
AECL205	Urdu Shayari : Kawayed aur Balagat Ka Mutala	AEC	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
8 (2 books)	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Syllabus

पुस्तक १. उर्दू ग़ज़ल का मुताला

घटक १. मीर तक़ी मीर और मिर्ज़ा ग़ालिब

घटक २. मोमीन खान मोमीन और दाग़ देहलवी

घटक ३. फ़िराक़ गोरखपुरी और हसरत मोहानी

घटक ४. जिगर मुरादाबादी और नासिर काज़मी

पुस्तक २. उर्दू नज़्म का मुताला

घटक १. नज़ीर अकबराबादी और हाली

घटक २. इक़बाल और चक्बस्त

घटक ३. अख्तर शीरानी और जोश मलीहाबादी

घटक ४. फैज़ अहमद फैज़ और अख्तरूलइमान

Course details

Course Code	Course	Category	Course Type	Credits
AISM101	Fundamentals of AI	Minor	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Understand the fundamental concepts, history, applications, and impact of Artificial Intelligence.

CO2: Apply problem-solving techniques and search algorithms to solve AI-based computational problems.

CO3: Use knowledge representation and reasoning methods such as logic, ontologies, and rule-based systems to model intelligent behaviour.

CO4: Analyze machine learning fundamentals including supervised, unsupervised, neural networks, and deep learning concepts.

CO5: Evaluate ethical issues, bias, governance, and emerging trends in AI through applications and hands-on projects.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	–	2	1
CO2	2	3	1	–	2	1
CO3	2	2	1	–	2	1
CO4	2	2	2	–	3	1
CO5	1	1	1	–	3	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details
Unit 1	Introduction to Artificial Intelligence	• Definition and History of AI • AI vs Traditional Programming • Applications and Impact of AI
Unit 2	Problem Solving and Search Algorithms	• Uninformed Search (BFS, DFS) • Informed Search (A*, Greedy Search) • Constraint Satisfaction Problems
Unit 3	Knowledge Representation and Reasoning	• Propositional and Predicate Logic • Ontology and Semantic Web • Rule-Based Systems
Unit 4	Machine Learning Fundamentals	• Supervised and Unsupervised Learning • Neural Networks Overview • Introduction to Deep Learning
Unit 5	AI Ethics and Bias	• Ethical Considerations in AI • Bias and Fairness in AI Systems • AI Governance and Policies
Unit 6	AI Applications and Future Trends	• AI in Healthcare, Finance and Industry • AI Research and Future Developments • Hands-on AI Project

Reference Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell and Peter Norvig, Pearson Education.
2. Artificial Intelligence: Foundations of Computational Agents – David L. Poole and Alan K. Mackworth, Cambridge University Press.
3. Machine Learning – Tom M. Mitchell, McGraw-Hill Education.
4. https://ocw.mit.edu, https://online.stanford.edu, https://ai.google

Course details

Course Code	Course	Category	Course Type	Credits
AISM201	Machine Learning and Deep Learning	Minor	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain the fundamental concepts of Machine Learning, types of learning (supervised, unsupervised, reinforcement), ML workflow, and evaluation metrics.

CO2: Apply supervised learning techniques including regression and classification models with appropriate hyperparameter tuning methods.

CO3: Analyze and implement unsupervised learning techniques such as clustering, dimensionality reduction, and anomaly detection.

CO4: Design and evaluate deep learning models including neural networks, CNNs, RNNs, LSTMs, and transformer architectures.

CO5: Develop advanced deep learning and reinforcement learning models, and demonstrate deployment of machine learning solutions in real-world applications.

CO–PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	–	3	2
CO2	3	3	3	–	3	2
CO3	3	3	3	–	3	2
CO4	2	3	2	–	3	2
CO5	2	3	2	–	3	3

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details

Unit 1	Introduction to Machine Learning	• Types of Machine Learning
		  ○ Supervised Learning
		  ○ Unsupervised Learning
		  ○ Reinforcement Learning
		• ML Workflow and Tools
		• Evaluation Metrics

Unit 2	Supervised Learning Techniques	• Regression Models • Classification Models • Hyperparameter Tuning

Unit 3	Unsupervised Learning and Clustering	• K-Means and Hierarchical Clustering
		• Dimensionality Reduction
		  ○ PCA
		  ○ t-SNE
		• Anomaly Detection

Unit 4	Introduction to Deep Learning	• Neural Network Architecture, • Activation Functions • Back propagation and Optimization
Unit 5	Convolutional and Recurrent Neural Networks	• CNN for Image Processing • RNN and LSTM for Sequential Data • Transformer Models
Unit 6	Advanced Deep Learning Concepts	• GANs and Auto encoders • Reinforcement Learning • Deploying ML Models

References Books

1. Machine Learning – **Tom M. Mitchell**, McGraw-Hill Education.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – **Aurélien Géron**, O'Reilly Media.
3. Deep Learning – **Ian Goodfellow, Yoshua Bengio, Aaron Courville**, MIT Press
4. Pattern Recognition and Machine Learning – **Christopher M. Bishop**, Springer.
5. Deep Learning with Python – **François Chollet**, Manning Publications.
6. https://ocw.mit.edu
7. https://online.stanford.edu
8. https://developers.google.com/machine-learning/crash-course

Course details

Course Code	Course	Category	Course Type	Credits
AISM202	Lab on Machine Learning	Minor	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

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

CO1: Implement machine learning algorithms using programming tools.

CO2: Perform data preprocessing and visualization.

CO3: Train and test machine learning models using datasets.

CO4: Evaluate model performance using appropriate metrics.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**3**	1	–	**3**	1
CO2	**3**	2	**3**	–	**3**	1
CO3	**3**	**3**	**3**	–	**3**	1
CO4	**3**	2	**3**	–	**3**	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

Practical No.	Unit Name	Activities
1	Setting Up ML Environment	• Installing Python, Jupyter, and Libraries • Data Import and Pre-processing • Exploratory Data Analysis
2	Supervised Learning Implementation	• Linear and Logistic Regression • Decision Trees and Random Forests • Model Evaluation Techniques
3	Unsupervised Learning Implementation	• Clustering Techniques • PCA and Feature Engineering • Anomaly Detection Use Cases
4	Deep Learning Basics	• Building Neural Networks with TensorFlow/Keras • Training and Evaluating Deep Models • Fine-tuning Hyperparameters
5	Real-World ML Applications	• ML in Image Processing • ML in Text Processing • Fraud Detection with ML
6	Project and Model Deployment	• End-to-End ML Project • Model Deployment using Flask/Django • Model Monitoring and Maintenance

References

- Hands-On Machine Learning with Scikit-Learn Keras and TensorFlow – Aurélien Géron, O'Reilly Media.
- Python Machine Learning – Sebastian Raschka and Vahid Mirjalili, Packt Publishing.
- Machine Learning – Tom M. Mitchell, McGraw-Hill Education.
- Deep Learning with Python – François Chollet, Manning Publications.
- Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer.
- Online Educational Resources (OER / OEL)

https://www.kaggle.com/learn

- NPTEL

  https://nptel.ac.in., https://www.tensorflow.org/tutorials
- https://developers.google.com/machine-learning., https://www.coursera.org

Course details

Course Code	Course	Category	Course Type	Credits
IOTM101	Fundamentals of IoT	Minor	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Understand the fundamentals, evolution, architecture, and applications of the Internet of Things (IoT).

CO2: Explain IoT architectures, communication models, and protocols used for device-to-device and system-level interactions.

CO3: Analyze IoT enabling technologies including sensors, actuators, cloud, edge computing, and AI integration.

CO4: Evaluate IoT communication technologies, connectivity challenges, and security and privacy issues in IoT systems.

CO5: Assess emerging trends such as 5G, AIoT, and digital twins for future IoT applications and innovations.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	2	1
CO2	2	2	1	3	1	1
CO3	2	1	2	–	3	1
CO4	2	1	1	3	1	1
CO5	1	1	1	–	3	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details
Unit 1	Introduction to IoT	• Definition, Evolution, and Importance of IoT • IoT Ecosystem and Components • Applications of IoT (Smart Cities, Healthcare, Industry, etc.)
Unit 2	IoT Architecture and Protocols	• IoT Layers: • Perception Layer • Network Layer • Application Layer • IoT Communication Models • M2M vs. IoT
Unit 3	IoT Enabling Technologies	• Role of Sensors and Actuators • Cloud and Edge Computing in IoT • AI and Machine Learning in IoT

Unit 4	IoT Communication Technologies:	• Wireless Technologies
		  ○ Wi-Fi
		  ○ Bluetooth
		  ○ Zigbee
		  ○ LoRa
		• LPWAN Technologies
		  ○ NB-IoT
		  ○ Sigfox
		• IoT Connectivity Challenges

Unit 5	Security and Privacy in IoT	• Security Threats and Solutions in IoT • Data Privacy Concerns • IoT Security Standards
Unit 6	IoT Future Trends	• 5G and IoT • AIoT (AI + IoT) • Digital Twins and IoT

Reference Books

1. Internet of Things: A Hands-On Approach – Arshdeep Bahga and Vijay Madisetti, Universities Press.
2. Internet of Things: Principles and Paradigms – Rajkumar Buyya and Amir Vahid Dastjerdi, Morgan Kaufmann.
3. The Internet of Things: Key Applications and Protocols – Olivier Hersent, David Boswarthick, and Omar Elloumi, Wiley.
4. Designing the Internet of Things – Adrian McEwen and Hakim Cassimally, Wiley.
5. Building the Internet of Things – Maciej Kranz, Wiley.
6. From Machine-to-Machine to the Internet of Things – Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, and David Boyle, Academic Press.
7. Security and Privacy in Internet of Things (IoTs) – Fei Hu, CRC Press..

Course details

Course Code	Course	Category	Course Type	Credits
IOTM201	IoT Hardware and Software	Minor	Theory	2

Learner Support and Academic Components:

No. of Units	Counselling hours	Total Study Hours (Learner)	No. of Assignments (CA)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	1	15 marks	35 marks

1 Counselling = 1 clock hour

Course Outcomes

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

CO1: Explain the architecture and components of IoT systems, including microcontrollers, microprocessors, and IoT hardware platforms.

CO2: Differentiate and interface various sensors and actuators in IoT-based applications.

CO3: Develop basic IoT applications using embedded programming (C/Python) and GPIO interfacing techniques.

CO4: Analyze IoT software platforms, operating systems, communication protocols (MQTT, CoAP, HTTP), and middleware solutions.

CO5: Design and implement a basic IoT system for real-world applications such as smart home automation.

CO–PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	2	3	1
CO2	3	3	1	2	3	1
CO3	3	3	2	2	3	2
CO4	2	3	2	3	3	2
CO5	2	3	2	2	3	2

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

Syllabus

Unit	Title	Details

Unit 1	IoT Hardware Overview	• Microcontrollers vs. Microprocessors
		• IoT Hardware Platforms:
		  ○ Arduino
		  ○ ESP8266
		  ○ Raspberry Pi

Unit 2	Sensors and Actuators:	• Analog vs. Digital Sensors
		• Actuators
		  ○ Motors
		  ○ Relays
		  ○ Servos

Unit 3	Microcontroller Programming Basics	• Embedded C and Python for IoT • GPIO Control and Sensor Interfacing

Unit 4	IoT Software Platforms	• IoT Operating Systems
		  ○ Contiki
		  ○ FreeRTOS
		• IoT IDEs
		  ○ Arduino IDE
		  ○ PlatformIO

Unit 5	IoT Protocols and Middleware	• MQTT • CoAP • HTTP • IoT Middleware Platforms
Unit 6	IoT System Design:	• Designing a Basic IoT System • Case Study: Smart Home Automation

References Books

1. Internet of Things: A Hands-On Approach – Arshdeep Bahga and Vijay Madisetti, Universities Press.
2. Designing the Internet of Things – Adrian McEwen and Hakim Cassimally, Wiley.
3. Getting Started with the Internet of Things – Cuno Pfister, O'Reilly Media.
4. The Internet of Things: Key Applications and Protocols – Olivier Hersent, David Boswarthick, and Omar Elloumi, Wiley.
5. Building the Internet of Things – Maciej Kranz, Wiley.
6. Learning Internet of Things – Peter Waher, Packt Publishing.
7. Raspberry Pi Cookbook – Simon Monk, O'Reilly Media.

Course details

Course Code	Course	Category	Course Type	Credits
IOTM202	Lab on Microcontrollers	Minor	Practical	2

Learner Support and Academic Components:

Number of Practical activities	Lab sessions	Total Study Hours (Learner)	Continuous Assessment (CA)	End Exam (EE)
6	6	60	25 marks	25 marks

1 session = 2 clock hours

Course Outcomes (COs)

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

CO1: Understand the architecture and basic functioning of microcontrollers used in IoT systems.

CO2: Develop programs to control microcontroller input/output pins and interface sensors and actuators.

CO3: Implement simple embedded applications using microcontroller programming environments.

CO4: Design and test basic IoT hardware prototypes using microcontroller platforms.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	1	–	**2**	**3**	1
CO2	**3**	**3**	–	**2**	**3**	1
CO3	**3**	**3**	–	1	**3**	2
CO4	**3**	**3**	–	**2**	**3**	**2**

3 = Strong Contribution, 2 = Moderate Contribution, 1 = Slight Contribution, Blank = No Contribution

List of Practicals

Practical No.	Unit Name	Activities
1	Introduction to Microcontrollers	• Microcontroller Architecture • Comparison of Arduino, ESP32 and Raspberry Pi
2	GPIO and Peripheral Interfacing	• Working with LEDs, Switches and Buzzer • PWM Control of Actuators
3	Sensor Interfacing	• Interfacing Temperature, Motion, and Light Sensors • Analog vs. Digital Sensor Readings
4	Communication Protocols	• I2C, SPI, UART Implementation • Wireless Communication with Bluetooth and Wi-Fi
5	Power Management in IoT Devices	• Energy Efficiency Techniques • Sleep Modes in Microcontrollers
6	Hands-on IoT Projects	• Implementing a Weather Monitoring System • Home Automation with Sensor Control

Reference Books

1. Internet of Things: A Hands-On Approach – Arshdeep Bahga and Vijay Madisetti, Universities Press.
2. Exploring Arduino: Tools and Techniques for Engineering Wizardry – Jeremy Blum, Wiley.
3. Getting Started with the Internet of Things – Cuno Pfister, O'Reilly Media.
4. Arduino Cookbook – Michael Margolis, O'Reilly Media.
5. Beginning Sensor Networks with Arduino and Raspberry Pi – Charles Bell, Apress.
6. Programming the Raspberry Pi: Getting Started with Python – Simon Monk, McGraw-Hill.

CCRX201 to CCRX206: [Practical: 2 Credits]

Semester III						
Course Code	**Course Name**	**Theory/ Practical /Project**	**Total Study (HRS)**	**Credit Points**	**Assessment Type**	**Passing Marks**
CCRX201	Health and Wellness-III	Practical	60	2	CA (20/50)	20/50
CCRX202	Yoga Education-III	Practical	60	2	CA (20/50)	20/50
CCRX203	Sports and Fitness-III	Practical	60	2	CA (20/50)	20/50
CCRX204	Cultural Activities-III	Practical	60	2	CA (20/50)	20/50
CCRX205	NSS-III	Practical	60	2	CA (20/50)	20/50
CCRX206	Fine/Applied/Visual/Performing Arts-III	Practical	60	2	CA (20/50)	20/50