



Re-Accredited 'B++' 2.88 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉદના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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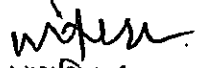
સંદર્ભ: (૧) એકેડેમિક કાઉન્સિલની તા. ૧૫/૦૬/૨૦૨૪ ની સભાના ઠરાવ ક્રમાંક:૯૦
(૨) અત્રેના વિભાગની તા. ૧૪/૦૮/૨૦૨૬ ની કાર્યાલય નોંધ

-: પરિપત્ર :-

યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે,
NEP-2020 અંતર્ગત શૈક્ષણિક વર્ષ ૨૦૨૬-૨૭ થી અમલમાં આવનાર B.Sc. Data Science (Honours)
Sem.-3 & 4 નો અભ્યાસક્રમ આ સાથે સામેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/૧૮૭૦૭/૨૦૨૬
તા. ૧૭/૦૮/૨૦૨૬


કુલસચિવ

પ્રતિ,

- (૧) યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓ.
.....આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકો/વિદ્યાર્થીને જાણ કરી અમલ કરવા સારું.
- (૨) ડીનશ્રી, કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા.
- (૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારું.

Veer Narmad South Gujarat University, Surat



Computer Science and Information Technology Faculty
Syllabus for (Semester-III and Semester-IV) of
B.Sc. (Data Science) (Honours)

As per NEP-2020

To be implemented from

Academic Year: June, 2026-2027

(Including Winter Session)

Veer Narmad South Gujarat University, Surat
Bachelor of Computer Science (Data Science) (Honours)
Under the Faculty of
Computer Science and Information Technology

Name of Program:	Bachelor of Science (Data Science) (Honours)
Abbreviation:	B.Sc. (Data Science and Analysis) (Honours): Four-year Integrated Program. With Multi-Level Entry and Exit option
Multi-level Exit Criteria:	i) Under Graduate Certificate in Computer Science: If the student wish to exit after completion of First year (Semester-1 and Semeter-2) without any back-log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship in addition to 6 credits from skill-based courses earned during first and second semester. ii) Diploma in Data Science and Analysis : If the student wish to exit after completion of Second year (Semester-1 to Semeter-4) without any back-log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship offered at end of first or second year in addition to 6 credits from skill-based courses earned during first four semesters. iii) B.Sc. (Data Science and Analysis) : If the student wish to exit after completion of Third year (Semeste-1 to semester-6) without any back-log and secure additional 4 credits from work based skill oriented university approved courses /vocational courses / summer internship / Apprenticeship offered at end of first or second year in addition to 6 credits from skill-based courses earned during first four semesters.
Multi-Level Entry Criteria:	As per the norms of the Veer Narmad South Gujarat University.
Duration:	4 year of B.Sc. (Data Science and Analysis) (Honors) degree program with multi level exit options at 1 st , 2 nd and 3 rd Year to obtain Certificate, Diploma, Degree and Honours Degree in Computer Application respectively.
Eligibility:	Candidate must have passed standard 12th (H.S.C.) Examination in Science (Any Group) / Commerce / vocational / General stream from Gujarat Higher Secondary Board (G.H.S.E.B.) or any other equivalent board (C.B.S.E. / I.C.S.E. etc. which must be approved and possess equivalence certificate from Veer Narmad South Gujarat University) with English as one of the subject. In case of candidates passed out from 12th Board from General Stream; Statistics/Economics/Business Mathematics/Accountancy/Computer must be one of the subjects. In case of Students passed out with 12th (H.S.C.) vocational stream, Computer and English must be one of the subject.
Objective of the Program:	The objective of the B.Sc. (Data Science and Analysis) program is to equip students with a strong foundation in computer applications while focusing on specialized skills in data science and analytics. Through a blend of theoretical knowledge and practical application, the program aims to prepare students to

	handle large datasets, analyze data using statistical methods and machine learning techniques, and derive meaningful insights to support decision-making processes in various industries. Students will also gain proficiency in programming languages, data visualization tools, and database management systems, enabling them to pursue careers as data analysts, data scientists, or pursue further studies in related fields.
Program Outcome:	PO1: Develop Proficiency in Data Analysis: Equip students with skills to collect, clean, analyze, and interpret data using statistical methods and advanced analytics techniques. PO2: Master Programming and Tools: Provide a strong foundation in programming languages (such as Python, R) and tools (like SQL, Tableau) essential for manipulating and visualizing data. PO3: Apply Machine Learning Algorithms: Enable students to apply machine learning algorithms to solve real-world problems, including supervised and unsupervised learning approaches. PO4: Understand Data Ethics and Security: Educate students about the ethical considerations and security challenges inherent in handling large datasets and implementing data-driven solutions. PO5: Prepare for Industry Roles: Prepare graduates to excel in roles such as data analysts, business analysts, or entry-level data scientists by integrating practical projects, internships, and industry-relevant skills into the curriculum.
Program Specific Outcome:	PSO1: Provide a solid foundation in computer science and mathematics necessary for data science, including programming languages, discrete mathematics, and calculus. PSO2: Train students in collecting, cleaning, and preprocessing large datasets from various sources to ensure data quality and readiness for analysis. PSO3: Equip students with statistical techniques such as hypothesis testing, correlation analysis, and regression analysis to derive insights and make data-driven decisions. PSO4: Develop proficiency in applying machine learning algorithms for tasks such as classification, clustering, regression, and natural language processing, supported by practical applications. PSO5: Familiarize students with tools and techniques for handling big data, including distributed computing frameworks like Hadoop and Spark, and NoSQL databases. PSO6: Enable students to effectively visualize data using tools like matplotlib, seaborn, or Tableau, and interpret visualizations to communicate insights effectively. PSO7: Educate students on the ethical implications and legal considerations related to data collection, storage, and usage, emphasizing privacy, security, and regulatory compliance. PSO8: Offer opportunities for students to engage in capstone projects and internships with industry partners, allowing them to apply their skills in real-world scenarios and gain practical experience in data science and analytics roles.

PO and PSO mapping:		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	PO1								
	PO2								
	PO3								
	PO4								
	PO5								
	PO6								
Medium of Instruction:	English								
Program Structure:	Semester-wise Breakup of the course is given as follows :								



Veer Narmad South Gujarat University, Surat
Program Structure: S.Y.B.Sc. (Data Science)
(SEM – 3 and SEM – 4)
(w.e.f. Academic Year June, 2026-2027)

Program Structure		Semester-wise break up for the courses :				
SEMESTER – 3						
Course Code	Course Title	Course Category	Level of Course	Course Credits	Teaching Hours/week	
				Th.+Pra.	Theory	Practical/Fieldwork/Project/Internship
301	Modern Indian Language (AEC-03) [Modern Indian Language (MIL)]	Ability Enhancement Course (AEC)	100-199 Introductory Level Course	2	2	0
302	Statistical Analysis using R (Student will opt any one course of multi-disciplinary nature from other than the computer Science and Application faculty).	Multi-Disciplinary Course (MDC)	200-299 Intermediate Level Course	4	2	4
303	Data Analytics using spreadsheet and Python	Major Course	300-399 Higher Level Courses	4	2	4
304	Data Wrangling and Data Visualization	Major Course	300-399 Higher Level Course	4	2	4
305	Web Designing – I	Major Course	300-399 Higher Level Course	4	2	4
	Practical (Based on Course Code:303,304 & 305 Equally divided)	No separate credits allocated for practical. The Practical exam/viva-voce will be based on Course 303,304 and 305				
306	Skill Enhancement Course-III (SEC-03)	Skill Enhancement Course	200-299 Intermediate Level Course	2	2	-
307	Value Addition Course – III (VAC-03)	Value Addition Course	200-299 Intermediate Level Course	2	2	-
Other Activities	The student is expected to participate in activities related to National Service Scheme (NCC), National Cadet Corps (NCC), adult education/literacy initiatives, mentoring school students, Elderly literacy program/ Environment preservation activities and other similar activities.			-	-	-
Total				22	14	16

Course Code	Course Title	Course Credit	University Exam Type	Exam Duration	External Marks	Internal Marks	Total Marks
301	Modern Indian Language (AEC-03)	2	Presentation & Viva-voce	1 Hours	25	25	50
302	Statistical Analysis using R (MDC: Multi-Disciplinary Course) (Student will opt any one course of multi-disciplinary nature from other than the computer Science and Application faculty)	4	Theory/Written: Practical :	1 Hours 2 Hours	50 25	25 25	100
303	Data Analytics using Spreadsheet and Python (Major Course)**	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
304	Data Wrangling and Data Visualization (Major Course)	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
305	Web Designing - I (Major Course)	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
306	Skill Enhancement Course-III (SEC-03)	2	-	-	25	25	50 [#]
307	Indian Knowledge System in context to Computers – 02 Value Addition Course-III (VAC-03)	2	Practical / Presentation:	2 Hours	25	25	50 [#]
Total		22			275	275	550

For Practical and Project:

- Batch Size – 40 Maximum (Desirable). Maximum 45 students can be accommodated in a batch. Separate batch should be considered if the student strength exceed 45 numbers.
- Practical includes Practical sessions for course-303, course-304 and course-305. **Minimum** Ten Practical hours (course-303, course-304 and course-305) per week should be allocated per batch in supervised mode and balance hours in un-supervised mode.
- The journal must be certified by the concerned faculty and by the Head of the Department, failing which the student will not be allowed to appear for External Practical Examination. Student will submit softcopy of Minor Project duly certified by the internal guide.

Program Passing Rules:	As per University rules.
Internal Marks Distribution :	For All Theory subjects (Out of 25) : Home Assignment (3 marks) + Class Assignment (3 Marks) + Attendance (4 Marks) + Internal Test (15 marks) For All Practical subjects (Out of 25) : Lab. work (3 marks) + Lab. Journal (3 Marks) + Attendance (4 Marks) + Internal Test (15 marks) For All Theory subjects (Out of 50) : Home Assignment (6 marks) + Class Assignment (6 Marks) + Attendance (8 Marks) + Internal Test (30 marks) For All Practical subjects (Out of 50) : Lab. work (6 marks) + Lab. Journal (6 Marks) + Attendance (8 Marks) + Internal Test (30 marks)



Course Code	Course Title	Course Credit	University Exam Type	Exam Duration	External Marks	Internal Marks	Total Marks
401	Organizational Softskills in Software Industry Ability Enhancement Course (AEC -02) ⁶	2	Presentation & Viva-voce	-	25	25	50
402	Internet of Things (IoT)	4	Theory/Written	2 Hours	50	50	100
403	Object Oriented Programming with Java	4	Theory/ Written	1 Hours	25	25	100
			Practical	2 Hours	25	25	
404	Data Visualization using Intelligent Data Analytic Tool	4	Theory/ Written	1 Hours	25	25	100
			Practical	2 Hours	25	25	
405	Fundamentals of Machine Learning	4	Theory/ Written	1 Hours	25	25	100
			Practical	2 Hours	25	25	
406	Skill Enhancement Course – IV (SEC-04)#	2	Theory/Written/Practical/Presentation/ Viva-voce	1 Hours	25	25	50 [#]
407	Value Added Course – IV (VAC-04)	2	-	1 Hours	25	25	50 [#]
Total		22			275	275	550

For Practical and Project:

- Batch Size – 40 Maximum (Desirable). Maximum 45 students can be accommodated in a batch. Separate batch should be considered if the student strength exceed 45 numbers.
- Practical includes Practical sessions for course-403, 404 and course-405. **Minimum** Ten Practical hours(2 Hours for course-403, 4 hours for course-404 and 4 hours for course-405) per week should be allocated per batch. Out of which 8 hours will be in supervised mode and balance hours in un-supervised mode.
- The journal should be certified by the concerned faculty and by the Head of the Department, failing which the student should not be allowed to appear for External Practical Examination. Student will submit softcopy of Minor Project duly certified by the internal guide.

Program Passing Rules:	As per University rules.
Program Fees : (Per Semester) (One time fees and exam fees are additional as prescribed by the university)	Semester Tuition Fees : As per the norms of University Semester Laboratory Utilization fees : As per University Norms [Other one time /affiliation /exam fees, will be as per the norms of the University] [For all certificate course fees, Skill Enhancement Courses and Value Addition Courses fees will be as per the prescribed limit for per credit as per the SOP of certificate courses decided by the university.]



SEMESTER – 4

Course Code	Course Title	Course Category	Level of Course	Course Credits	Teaching per week	
					Theory	Practical/ Fieldwork/P roject/ Internship
401	Organizational Soft-skills in Software Industry [Ability Enhancement Course-IV] (AEC-04) ⁵⁶ [Modern Indian Language (MIL) & English language focused on language and communication skills.]	Ability Enhancement Course	200-299 Intermediate level	2	2	0
402	Internet of Things (IoT)	Minor Course	200-299 Intermediate Level Course	4	4	0
403	Object Oriented Programming with Java	Major Course	300-399	4	3	2
404	Data Visualization using Intelligent Data Analytic Tool	Major Course	300-399 Intermediate Level Course	4	2	4
405	Fundamentals of Machine Learning	Major Course	300-399 Intermediate Level Course	4	2	4
	Practical (Based on Course Code: 403,404 & 405 : Equally Divided)	No separate credits allocated for practical. The Practical exam/viva-voce will be based on Course 403, 404-07 and 405-07.				
406	Skill Enhancement Course-IV (SEC-04)	Skill Enhancement Course	200-299 Intermediate Level Course	2	2	-
407	Value Addition Course – IV (VAC-04)	Value Addition Course	200-299 Intermediate Level	2	2	-
Other Activities	The student is expected to participate in activities related to National Service Scheme (NCC), National Cadet Corps (NCC), adult education/literacy initiatives, mentoring school students, Elderly literacy program / Environment preservation activities and other similar activities.			-	-	-
Total				22	17	10

Semester - 3**Course Code: 301****Course Title: The Prominent Gujarati Literary Texts****(પ્રસિદ્ધ ગુજરાતી સાહિત્યિક કૃતિઓ)****Course Category: A.E.C. (Ability Enhancement Course)**

Course Code	301
Course Title	The Prominent Gujarati Literary Texts (પ્રસિદ્ધ ગુજરાતી સાહિત્યિક કૃતિઓ) [The student is independent to select any other course as per the NEP standards (online/MOOC/Recognized university approved AEC course) or from courses offered by college/institute out of the course basket offered by the University under the Ability Enhancement courses (AEC) basket.]
Credits	2
Course Category	(AEC) Ability Enhancement Course
Level of Course	100-199 (Foundation / Introductory)
Course Intake	As per the division intake allocated by University
Course Resource Person:	The institute can invite a professional/expert resource person of the concerned field from any other institute.
Course Fees:	-
Teaching per Week	2 Hrs
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2024-2025
Purpose of Course	The prominent Gujarati Literary Texts aims to deepen participants' understanding of the rich literary heritage of Gujarat. This program focuses on exploring the prominent literature and characters within Gujarati novels, fostering a nuanced appreciation for cultural nuances, historical contexts, and literary techniques. By delving into the intricacies of Gujarati literature, participants can enhance their analytical and critical thinking skills while gaining a broader cultural perspective. [Modern Indian Language (MIL) & English language focused on language and communication skills.]
Course Objective	1) Cultural Appreciation: Foster a deep appreciation for the cultural heritage of Gujarat by studying prominent literature and characters in Gujarati texts, allowing participants to understand the societal values, traditions, and historical contexts depicted in the literary works. 2) Literary Analysis Skills: Develop participants' analytical and critical thinking skills through an in-depth examination of the narrative structures, themes, and character developments found in Gujarati texts, thereby enhancing their ability to critically assess and interpret literature. 3) Historical Contextualization: Provide participants with the necessary historical background to comprehend the evolution of Gujarati literature, enabling them to connect literary movements and periods with the societal changes and influences that shaped the works. 4) Communication Proficiency: Enhance participants' communication skills by encouraging them to articulate their interpretations and analyses of Gujarati literature effectively, fostering the ability to express complex ideas and perspectives both verbally and in writing. 5) Cultural Sensitivity: Promote cultural sensitivity and cross-cultural understanding by exploring the diverse characters and narratives within Gujarati texts, encouraging participants to recognize and appreciate the pluralistic nature of Gujarati literature and its reflections on society.
Pre-requisite	Knowledge of Gujarati (Reading, Writing and Speaking)

Course Outcomes	CO1: Comprehensive Knowledge of Prominent Gujarati Novels: Students will gain a deep understanding of the historical context, cultural nuances, and literary themes of four prominent Gujarati texts that explore historical facts and events. This outcome aims to foster a critical appreciation of the literature's connection to historical narratives. CO2: Analysis of Key Characters in Gujarati Novels: Students will analyze and evaluate the main characters in the selected Gujarati texts, examining their motivations, development, and significance within the historical context. This outcome encourages students to delve into character studies and understand the author's portrayal of individuals against the backdrop of historical events. CO3: Cultural Sensitivity and Contextual Awareness: Through the exploration of Gujarati texts, students will develop cultural sensitivity and contextual awareness, gaining insights into the social, political, and historical aspects that influence the literature. This outcome aims to enhance students' ability to interpret literature within its broader cultural and historical framework. CO4: Critical Evaluation of Literary Techniques: Students will critically evaluate the literary techniques employed by prominent Gujarati novelists, examining narrative structures, symbolism, and stylistic choices. This outcome encourages students to develop a discerning eye for the artistic elements that contribute to the richness of Gujarati literature. CO5: Understanding Mahatma Gandhi's Autobiography in Gujarati Literature: By studying Mahatma Gandhi's autobiography written in Gujarati, students will gain insights into his life, philosophy, and the socio-political landscape of the time. This outcome aims to connect the literary exploration of historical events with the personal narrative of one of the most influential figures in history, fostering a holistic understanding of the period.																																																						
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)	<table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	CO1									CO2									CO3									CO4									CO5								
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Course Content	Unit-1: "જય સોમનાથ " - લેખક : કનૈયાલાલ મુન્શી - પરિચય અને ઐતિહાસિક સંદર્ભ: નવલકથાના પ્લોટ અને થીમ્સની ઝાંખી સોમનાથ મંદિરની ઐતિહાસિક પૃષ્ઠભૂમિ અને પાત્રોનું વિશ્લેષણ અને તેમનું ઐતિહાસિક મહત્વ. - ગુજરાતનું સાંસ્કૃતિક વિહંગલોકન : નવલકથામાં દર્શાવવામાં આવેલા સાંસ્કૃતિક તત્વોનું અન્વેષણ. નવલકથા અને સમકાલીન ગુજરાતમાં સાંસ્કૃતિક વ્યવહારનો તુલનાત્મક અભ્યાસ. Unit-2 : "સત્યના પ્રયોગો" - લેખક: મહાત્મા ગાંધી - સાહિત્યિક સ્વરૂપ તરીકે આત્મકથા: ગાંધીજીની વર્ણન શૈલીનું મહત્વ. ગાંધીજીની ફિલસૂફી પર વ્યક્તિગત અનુભવોની અસરનું વિશ્લેષણ. - નૈતિક અને તાત્વિક પ્રતિબિંબ: સત્ય અને અહિંસા સાથે ગાંધીજીના પ્રયોગોનું અન્વેષણ.સમકાલીન સમાજમાં ગાંધીવાદી સિદ્ધાંતોની સુસંગતતા પર ચર્ચા. Unit-3 : "સિંહપુરુષ" - લેખક : ડૉ. શરદ ઠાકર - પરિચય અને ઐતિહાસિક સંદર્ભ: સ્વતંત્રતા આંદોલન અને સ્વાધીનતા સંગ્રામ ના વિવિધ પાસા. - વીર સાવરકરની જીવનયાત્રા અને વિચારો. - કાળાપાણીની સજા અને આંદામાન-નિકોબારની જેલમાં વિતાવેલ કઠિન સમય. - જીવન ચરિત્ર અને સ્વતંત્રતા માટેની દ્રઢતા. Unit-4: "પેલે પાર નો પ્રવાસ" : લેખક : રાધાનાથ સ્વામી - આધ્યાત્મિક અને વ્યક્તિગત વૃદ્ધિ: સ્વામી રાધાનાથની ભારત યાત્રા .																																																						

	- સ્વ ની ખોજ માટે ભારતના તત્વજ્ઞાન અને આધ્યાત્મિક જ્ઞાન માટે ના અનુભવો. - સ્વ-શોધની ભૂમિકા પર ચર્ચા - આંતર-સાંસ્કૃતિક અનુભવો - વિવિધ સંસ્કૃતિઓના નવલકથાના ચિત્રણનું વિશ્લેષણ, વિવિધતામાં એકતા સંબંધિત તત્વનું અન્વેષણ. - ભારત પ્રવાસ દરમિયાન થયેલ અનુભવો. Unit-5: "મહા-માનવ સરદાર " - લેખક: દિનકર જોશી - જીવન ચરિત્ર અને ઘડતર. - લોહપુરુષ ની જીવન યાત્રા અને આઝાદી ની ચળવળમાં ભૂમિકા. - આઝાદ ભારતના શિલ્પી અને રાજ્યોનું એકત્રીકરણ - આધુનિક ભારત અને ભવિષ્યના ભારત અંગેના વિચારો.
Reference Books	1) "મહા-માનવ સરદાર " - લેખક: દિનકર જોશી , ISBN: 9788177907032 (ISBN10: 8177907034), Pravin Prakashan 2) "Pele Parno Pravas" (Gujarati Of The Journey Home), Radhanath Swami, Publisher: Tulasi Books, ISBN: 9788191035537 3) "સિંહપુરુષ" - લેખક : ડો. શરદ ઠાકર, Publisher: Navbharat sahyi Mandir, ISBN-10. 8190240897 ; ISBN-13. 978-8190240895. 4) "Saty na prayogo", લેખક : Mahatma Gandhi, Publisher: Navjivan Trust ,ISBN(13): 978-8172290429. 5) "જય સોમનાથ " - લેખક : કનૈયાલાલ મુન્શી, ISBN(13): 978-9351751328
Teaching Methodology	Class Work, Discussion, Self-Study, Case-Study, Seminars , Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, - One presentation by the student on given topic, - A book review report on given topic of the book and participation in group discussion. 50% External assessment. Seminar exam will be conducted by the two appointed examiners by the college/institute (Criteria for examiner appointment: Similar to the practical examiners appointed at graduation level who are expert in the subject.) - Final review report consist of minimum 3000 words will be prepared and presented by the student on one of the book selected from the five books of the syllabus. (40% weightage) - Student will also prepare detailed critical analysis of any two characters from the available books in the syllabus and prepare a presentation and report(minimum 600 words on each character selected by the student.) (40% weightage) - The examiners can also conduct Viva-voce on the presentation given by the student interaction with the student to evaluate student's understanding about the books and characters. (20% weightage)



Course Code: 302
Course Title: Statistical Analysis using R
[Subject code-2611001503044001]

Course Code	302
Course Title	Statistical Analysis using R (Multi-Disciplinary Course – 03)
Credits	4
Course Category	Multidisciplinary Course (MDC-03)
Level of Course	200-299 (Intermediate Level Course)
Teaching per Week	2 Hours (Theory) + 4 Hours (Practical).
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Cognitive Skills of the Course	This course enhances critical thinking and problem-solving skills by encouraging students to analyze datasets, identify patterns, and apply statistical techniques in real-world scenarios. Students will develop analytical skills in selecting appropriate methods for data cleaning, transformation, and visualization. Additionally, they will learn to interpret statistical results and communicate findings effectively, fostering a deeper understanding of statistical concepts and data-driven decision-making. Remembering: The ability to recall facts, terms, and basic concepts from memory. Example: Listing statistical terms or recalling R functions. Understanding: The ability to explain ideas or concepts in your own words. Example: Describing the difference between mean and median. Application: Using learned concepts and knowledge in new or practical situations. Example: Applying data cleaning techniques in R to a new dataset. Analysis: Breaking down complex information into smaller parts and understanding relationships. Example: Analyzing a dataset to identify trends or outliers. Evaluation: Making judgments or forming opinions based on criteria and evidence. Assessing which statistical method is most appropriate for a specific dataset. Creation: Combining learned elements to form new patterns or structures. Example: Designing a new analysis pipeline or building a custom R function for data pre-processing.
Course Objective	1. To Develop a Strong Understanding of Statistical Concepts: Students will learn the fundamental concepts of statistics, including measures of central tendency, dispersion, and data sampling techniques, and how they are applied in data analysis. 2. To gain knowledge on Data Manipulation and Preprocessing: Students will gain proficiency in data cleaning, filtering, and transformation using R, preparing datasets for meaningful analysis. 3. To learn to Import, Visualize, and Analyze Data Using R: Students will acquire skills in importing data from various sources (CSV, SQLite), visualizing distributions, and performing statistical analysis through R. 4. To enhance Problem-Solving Skills through Data Visualization: Students will develop the ability to visualize and interpret univariate and bivariate data distributions using R's powerful plotting libraries like ggplot2. 5. To apply Statistical Analysis to Real-World Data: Students will be able to apply statistical methods to real-world datasets, conducting hypothesis testing, generating insights, and making data-driven decisions using R.
Pre-requisite	Knowledge of Fundamentals of Statistics and Mathematics of 10 th Grade Level

Course Outcomes	CO1: Understand foundational statistical concepts including descriptive statistics, probability theory, and basic inferential statistics. CO2: Apply statistical techniques such as hypothesis testing, confidence intervals, and correlation analysis to analyze and interpret data accurately. CO3: Demonstrate proficiency in data visualization methods to effectively communicate statistical findings and insights. CO4: Utilize basic statistical software tools or programming languages like R or Python to perform data analysis and visualization tasks. CO5: Develop critical thinking skills to assess the validity and reliability of statistical analyses and draw appropriate conclusions from data. CO6: Apply statistical reasoning to real-world scenarios and make informed decisions based on data-driven insights.									
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
	CO6									
Course Outcome	Upon completing the course, students will be able to apply statistical techniques using R to clean, analyse, and visualize data. They will develop skills in data manipulation, statistical analysis, and visualization, enabling them to make data-driven decisions and solve real-world problems.									
Course Content	Unit-1: Basic Statistical Concepts and Data Sampling Techniques: 1.1 Population vs. Sample: 1.1.1 Understanding the difference between population and sample, significance, and applications in statistics. 1.2 Central Tendency: 1.2.1 Measures of central tendency (mean, median, mode) and their use in statistical analysis. 1.3 Measures of Dispersion: 1.3.1 Understanding concept of Data Dispersion, skewness, correlation. 1.3.2 range, variance, standard deviation, and their importance in summarizing data. 1.4 Data Sampling Techniques: 1.4.1 Introduction to sampling methods: random sampling, stratified sampling, and their applications in data analysis. Unit-2: Introduction to R and Basic Data Representation : 2.1 Overview of R: 2.1.1 Concepts of R, its syntax, and applications in data analysis and statistics. 2.2 R Syntax: 2.2.1 Introduction to R syntax, basic operations, and expressions. 2.3 Variables and Data Types in R: 2.3.1 Understanding different data types in R (numeric, character, logical, etc.), and working with variables. 2.4 Data Importing in R: 2.4.1 Fetching data from CSV files and SQLite databases using R. 2.5 Data Representation in R: Visualizing data using histograms, box plots, and scatter plots. Unit-3: Data Preprocessing and Cleaning in R 3.1 Data Importing Techniques: 3.1.1 Fetching data from CSV files 3.1.2 Using read.csv(), read.table(), dplyr and RSQLite 3.1.2 SQLite databases into R. 3.2 Data Preprocessing in R:									

	3.2.1 Overview of preprocessing steps: 3.2.1.1 Cleaning, filtering 3.2.1.2 Transforming data for analysis. 3.3 Handling Missing Data: 3.3.1 Identifying and dealing with missing data values in R. 3.4 Data Cleaning and Transformation: 3.4.1 Techniques for data cleaning (removing duplicates, correcting inconsistencies), 3.4.2 Transforming data (type conversion, recoding variables). Unit-4: Data Manipulation and Visualization in R 4.1 Data Frame Manipulation: 4.1.1 Reordering, reshaping 4.1.2 Merging data frames in R. 4.2 Data Summary Statistics: 4.2.1 Calculating and summarizing key statistics (mean, median, mode, standard deviation) in R. 4.3 Visualizing Data Distributions: 4.3.1 Exploring and visualizing data distributions with R 4.3.2 Generating a Bell curve using normal distribution. 4.4 Graphical Representation of Univariate and Bivariate: 4.4.1 Univariate analysis and plot using ggplot2: 4.4.1.1 Box plot, Histogram, Bar plot, Density Plot 4.4.2 Bivariate analysis and plot using ggplot2: 4.4.2.1 Scatter plot, Box Plots, Line plots.
Reference Books	1. "An Introduction to Statistical Learning: with Applications in R" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Publisher: Springer, ISBN: 978-1461471370 2. "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data" by Hadley Wickham and Garrett Grolemund, Publisher: O'Reilly Media, ISBN: 978-1491910399 3. "Discovering Statistics Using R" by Andy Field, Jeremy Miles, and Zoe Field Publisher: SAGE Publications Ltd, ISBN: 978-1446200469 4. "Practical Data Science with R" by Nina Zumel and John Mount Publisher: Manning Publications, ISBN: 978-1617291562 5. "Statistics: Unlocking the Power of Data" by Robin H. Lock, Patti Frazer Lock, Kari Lock Morgan, and Eric F. Lock, Publisher: Wiley, ISBN: 978-1119325572 6. "The Art of R Programming: A Tour of Statistical Software Design" by Norman Matloff, Publisher: No Starch Press, ISBN: 978-1593273842 7. "Introduction to Probability and Statistics Using R" by G. Jay Kerns, Publisher: RStudio, PBC, ISBN: 978-1886529450 8. "Business Analytics – The science of Data-Driven Decision Making" by U.Dinesh Kumar, Publisher: Wiley, ISBN: 978-81-265-6872-2
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. (Practical +Theory) 50% External assessment. - Written Theory exam - Practical Exams

[Subject code for Practical-2611001503011002]

Course Code: 303

Course Title: Data Analytics using Spreadsheet and Python

[illegible]

Course Content	UNIT – 1: Advanced Excel for Data Cleaning and Analysis 1.1 Essential Excel Functions for Analytics 1.1.1 Nested IF and IFS 1.1.2 Lookup Functions: VLOOKUP, XLOOKUP, INDEX-MATCH 1.1.3 Common Text Functions: LEFT, RIGHT, MID, FIND, SUBSTITUTE 1.1.4 Logical Functions: IF, AND, OR, NOT, IFERROR 1.1.5 Array Formulas: FILTER, SORT, UNIQUE 1.2 Practical Data Cleaning in Excel 1.2.1 Identifying and Removing Duplicates 1.2.2 Handling Missing or Inconsistent Values 1.2.3 Using TRIM, CLEAN, and Text-to-Columns 1.2.4 Flash Fill and Smart Fill Techniques 1.2.5 Data Summarization Using Pivot Tables 1.2.6 Using Conditional Formatting for Insights UNIT – 2: Excel-Based Analytics and Visualization 2.1 Regression and Forecasting Basics 2.1.1 Linear Regression using Excel 2.1.2 Forecasting with Trendlines and Data Analysis Toolpak 2.1.3 Scenario Analysis: Goal Seek, What-If, Solver 2.2 Visual Representation of Data 2.2.1 Common Chart Types: Column, Line, Combo, Histogram 2.2.2 Advanced Charts: Box Plot, Waterfall 2.2.3 Sparklines and In-cell Charts for Trends 2.2.4 Creating Interactive Dashboards using Form Controls 2.2.5 Pivot Charts and Data Storytelling with Charts UNIT – 3: Python for Data Processing 3.1 Functional Python Programming 3.1.1 Lambda Functions and Their Utility 3.1.2 Map, Filter, and Reduce Functions for Efficient Data Processing 3.1.3 Using These Functions in Preprocessing Tasks 3.2 Comprehensions for Clean Code 3.2.1 List and Dictionary Comprehensions 3.2.2 Writing Compact Loops for Data Filtering and Transformation 3.3 Basics of Data Handling in Python 3.3.1 Reading and Writing CSV Files with Pandas 3.3.2 Handling Missing Values and Filtering Data UNIT – 4: Introduction to SQLite and File Handling in Python 4.1 Fundamentals of SQLite 4.1.1 What is SQLite? Features and Use-Cases 4.1.2 Understanding SQLite Data Types: NULL, INTEGER, TEXT, etc. 4.2 Database Dumping and Backups 4.2.1 Exporting Table Data into Files 4.2.2 Dumping Entire Database Structures or Specific Tables 4.3 Working with Text Files in Python 4.3.1 Reading and Writing Text Files 4.3.2 Appending, Deleting, and Truncating File Content 4.3.3 File Operations for Storing Logs or Cleaned Data
Reference Books	1. Microsoft Excel 2019 Bible Author: Michael Alexander, Richard Kusleika Publisher: Wiley ISBN: 978-1119517948. 2. Excel 2021 for Dummies Author: Greg Harvey Publisher: Wiley ISBN: 978-1119830719. 3. Data Analysis Using Microsoft Excel Author: Michael R. Middleton Publisher: Cengage Learning ISBN: 978-8131528162. 4. Python for Data Analysis Author: Wes McKinney Publisher: O'Reilly Media ISBN: 978-1491957660. 5. Fluent Python: Clear, Concise, and Effective Programming Author: Luciano Ramalho Publisher: O'Reilly Media ISBN: 978-1492056355

	6. Learning with Python Author: Allen Downey Publisher: DreamTech Press ISBN: 978-9351198147. 7. Mastering Python for Data Science Author: Samir Madhavan Publisher: Packt Publishing ISBN: 978-1783551712 8. Using SQLite Author: Jay A. Kreibich Publisher: O'Reilly Media ISBN: 978-0596521189 9. SQL in 10 Minutes, Sams Teach Yourself Author: Ben Forta Publisher: Sams Publishing ISBN: 978-0672336072 10. Automate the Boring Stuff with Python Author: Al Sweigart Publisher: No Starch Press ISBN: 978-1593279929
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course Code: 304

Course Title: Data Wrangling and Data Visualization

Course Code	304
Course Title	Data Wrangling and Data Visualization
Credits	4
Course Category	Major Course
Level of Course	300-399 (Intermediate Level)
Teaching per Week	2 Hours Theory + 4 Hours Practical work
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Purpose of Course	The purpose of this course is to equip students with practical skills and theoretical knowledge required to transform raw data into a clean and structured format for effective analysis. Students will gain hands-on experience in using Python libraries (like Pandas and Matplotlib) for data wrangling, visualization, exploratory analysis, and feature engineering. This course lays a foundational step for any data-driven domain, especially data science and machine learning.
Course Objective	1. Understand the role of data wrangling and cleaning in a data science workflow. 2. Perform DataFrame operations using Pandas for manipulating and analyzing datasets. 3. Create insightful visualizations to explore and present data using Matplotlib and Seaborn. 4. Combine, group, reshape, and filter large datasets efficiently. 5. Conduct Exploratory Data Analysis (EDA) to derive insights and detect patterns or anomalies. 6. Apply feature engineering techniques to prepare data for machine learning models. 7. Understand and implement encoding and feature scaling methods for numerical and categorical data.
Pre-requisite	Basic knowledge of Python programming (variables, loops, functions, data types). Familiarity with Python libraries like NumPy (basic level). Understanding of fundamental statistics (mean, median, standard deviation, etc.).
Course Outcomes	CO1: Define and differentiate between data wrangling, data cleaning, and preprocessing. CO2: Manipulate data effectively using Pandas operations like rename(), replace(), concat(), merge(), groupby(), and more. CO3: Visualize data through various charts like scatter plots, histograms, bar charts, and heatmaps using Matplotlib. CO4: Perform EDA by calculating statistical summaries, identifying outliers, analyzing distributions, and discovering relationships. CO5: Reshape and transform datasets using techniques such as pivoting, melting, and applying functions row/column-wise.

	4.1.2 Basic types of features: numeric, categorical, text 4.1.3 Creating new features using formulas (e.g., sum, average) 4.1.4 Extracting day/month/year from datetime 4.2 Encoding Categorical Data 4.2.1 Label Encoding: concept and demonstration 4.2.2 One-Hot Encoding using get_dummies() 4.2.3 Choosing the right encoding method 4.2.4 Bar plot for category comparison 4.3 Feature Scaling 4.3.1 Need for scaling and where it helps 4.3.2 Min-Max scaling and Standardization (Z-score) using sklearn 4.3.3 Visualization before and after scaling using boxplot/histogram
Reference Books	1. <i>Python for Data Science</i> , Dr. Mukesh Saraswat, BPB Publications, ISBN: 9789389328045 2. <i>Data Science with Python</i> , Henry Lopez, Shroff Publishers (India), ISBN: 9789352135886 3. <i>Data Analysis Using Python</i> , R. Nageswara Rao, Notion Press (India), ISBN: 9781636406692 4. <i>Data Analytics Made Accessible</i> , Anil Maheshwari, McGraw Hill Education (India), ISBN: 9789353164977 5. <i>Pandas for Data Analysis</i> , Ashish Kumar, Packt Publishing, ISBN: 9781789615325 6. <i>Python Data Science Handbook</i> , Jake VanderPlas, O'Reilly Media, ISBN: 9781491912058 7. <i>Practical Statistics for Data Scientists</i> , Peter Bruce, Andrew Bruce, O'Reilly Media, ISBN: 9781492072942 8. <i>Feature Engineering for Machine Learning</i> , Alice Zheng, Amanda Casari, O'Reilly Media, ISBN: 9781491953235 9. <i>Hands-On Exploratory Data Analysis with Python</i> , Suresh Kumar Mukhiya, Packt Publishing, ISBN: 9781789537252 10. <i>Data Wrangling with Pandas</i> , Jacqueline Kazil, Katharine Jarmul, O'Reilly Media, ISBN: 9781491948811
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course Code: 305
Course Title: Web Designing-I

[Subject code for Theory-2611001503033001] [Subject code for Practical-2611001503033002]

Course Code	305-01									
Course Title	Web Designing-I									
Credits	4									
Course Category	Major Course									
Level of Course	300-399 (Higher Level)									
Teaching per Week	2 Hours Theory + 4 Hours Practical work									
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)									
Review / Revision	-									
Implementation Year:	A.Y. 2026-2027									
Purpose of Course	- Design is the process of collecting ideas, and aesthetically arranging and implementing them, guided by certain principles for a specific purpose. - Web design is a similar process of creation, with the intention of presenting the content on electronic web pages, which the end- users can access through the internet with the help of a web browser. - This course deals with designing of websites.									
Course Objective	To make students aware of web terminology and website designing tools. Student can understand and implement the real functions of website development.									
Pre-requisite	Basic knowledge of Simple HTML and HTML-5 concepts, windows based applications. Some very basic acquaintance with computers and the www is assumed.									
Course Outcomes	CO1: Develop proficiency in HTML5 syntax and semantics, and CSS styling techniques for creating visually appealing web pages. CO2: Implement Bootstrap framework for rapid prototyping and responsive design, ensuring cross-browser compatibility and scalability. CO3: Utilize JavaScript for interactivity and dynamic content manipulation, incorporating libraries like jQuery for streamlined development. CO4: Demonstrate the ability to integrate HTML5, CSS, Bootstrap, and JavaScript to create cohesive and engaging web applications. CO5: Apply industry-standard practices in web development, including code optimization, version control, and responsive design principles.									
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	UNIT-1: Working with HTML5 and CSS: 1.1 concepts of CSS: 1.1.1 Adding CSS (Inline,Internal,External) 1.1.2 HTML Links and attribute.(_self, _blank, _parent, _top) 1.1.3 Absolute URL and Relative URL in <href> 1.1.4 tag and its attributes (src, alt, style,width,height) 1.2 HTML forms : 1.2.1 form Elements and their attributes : 1.2.1.1 form (action, method, novalidate, autocomplete,target) 1.2.1.2 label, input (text, radio button, Checkboxes, submit/reset button) 1.2.1.3 select(id, name,<option>), 1.2.1.4 textarea (name, rows, cols), 1.2.1.5 button(type, onclick) 1.2.1.6 datalist 1.2.2 Media : Video, Audio									

UNIT-2: Design Web Sites Using Bootstrap4

- 2.1 Bootstrap Introduction
- 2.2 Grid Structure
- 2.3 Table, Colours, Alerts, Form Controls
- 2.4 Buttons and ButtonGroups
- 2.5 Images, Media Objects
- 2.6 Pagination
- 2.7 Bootstrap Grids
- 2.8 Bootstrap Themes

UNIT-3: Overview of Java Script

- 3.1 Overview of Client & Server-Side Scripting
- 3.2 Structure of Java Script
- 3.3 Data types and Variables
- 3.4 Operators (Arithmetic, Assignment, Comparison, Logical and Conditional Operator)
- 3.5 Control Structure
 - 3.5.1 If...Else, switch..case
 - 3.5.2 While, Do...While, For Loop
 - 3.5.3 break, continue
- 3.6 Java Script String and Events
 - 3.6.1 Javascript Strings types
 - 3.6.2 String functions:
concat(), split(), indexOf(), lastIndexOf(), substring(), trim(), slice(), replace(), charAt()
 - 3.6.3 Javascript Events :
 - 3.6.3.1 Mouse Events : (click, mouseover, mouseremove, mouseout, mouseup)
 - 3.6.3.2 keyboard Events : (keyup,keydown)
 - 3.6.3.3 Form Event : (focus, submit, blur, change)

UNIT-4: JavaScript Objects :

- 4.1 Creating object :
(By object literal, By creating instance of Object, By using an object constructor)
- 4.2 Date object :
 - 4.2.1 Date constructor: Date(), Date(milliseconds), Date(dateString), Date(year, month, day, hours, minutes, seconds, milliseconds)
 - 4.2.2 Date Methods: getDate(), getDay(),getMonth(), getHours(), setDate, setMonth(),setDay(), toString()
- 4.3 Document Object Model (DOM):
 - 4.3.1 DOM concepts
 - 4.3.2 DOM properties
 - 4.3.3 DOM methods :
write(), writeln(),getElementById(),getElementsByName()
- 4.4 JavaScript Functions:
 - 4.1 JavaScript Functions:
 - 4.1.1 Defining function (with and without parameters)
 - 4.1.2 calling function
 - 4.1.3 return statement
 - 4.1.4 Page redirection
 - 4.2 Dialog boxes : Alert, confirm, prompt
 - 4.3 Form validation :
 - 4.3.1 Basic validation (All form details are filled)
 - 4.3.2 Data format validation
(email, number, string, mobile number, name)

[All Units carry Equal Weightage]

Reference Books	1. HTML & CSS: The Complete Reference - Thomas Powell - McGraw Hill Education 2. HTML Unleashed, Darnell Rick –Techmedia 3. HTML, XHTML, and CSS Bible - Steven M. Schafer – Wiley Publications 4. Cascading Style Sheets- The Definitive Guide, E. A Meyer –O'Reilly 5. JavaScript Programming for Absolute Beginner, Harris -PHI 6. JavaScript Step by Step, Suehring -PHI 7. Bootstrap in 24 Hours, Sams Teach Yourself - JenniferKyrnin 8. Learning Bootstrap 4 - Matt Lambert – Packt Publishing 9. Bootstrap Responsive Web Development - Jake Spurlock - O'Reilly Media. 10. JavaScript and JQuery (Interactive Front-End Web Development) by Jon Duckett 11. JavaScript and JQuery (The missing manual) by David Sawyer MCFarland
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course code: 306
Course Title: Skill Enhancement Course (SEC-03)

Course Code	306
Course Title	Skill Enhancement Course - III (SEC – 03)
Credit	2
Category of Course	Skill Enhancement Course
Level of Course	200-299 (Intermediate Level)
Teaching per Week	2 Hrs (Any or Combination of Theory/Practical/Fieldwork/Internship/Project)
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2025-2026
Purpose of Course	- As per NEP(National Education Policy-2020), it is mandatory for students to select a 2 credit Skill Enhancement Course out of the choices given by the college/institute. - It will be mandatory for the student to opt minimum one 2-credit Skill Enhancement Course out of the list of offered courses recognised by the University during semester-1 to semester-5. - The student can start an alternative career in the field by obtaining higher degree of knowledge in the area. - It's aimed at imparting practical skills, embedded internship, hands-on training, soft skills, life skills, such approved online courses etc. to enhance the employability of students. This may also include courses as per the need of new evolving technology.
Course Objective	Obtaining skill in particular field along with the regular curriculum of the selected program is essential. It not only enhance the skill but also provide an opportunity to develop skill in particular area where one can pursue career in future. Skill enhancement provides the opportunity and knowledge for an individual to develop and strengthen the necessary skills to gain, maintain, and advance in a chosen area. Skill enhancement programs are focused around training that combines the best practices from varieties of areas. Skill enhancement or training typically uses a combination of cognitive and behaviour problem solving approaches, both of which are used to strengthen a person's positive skill develop.
Pre-requisite	-
Course Content and Implementation road-map.	(i) University has categorised and prepared the basket of the courses including approved online courses that can be offered as Skill Enhancement Course. (ii) The institute/college/department can design and implement skill enhancement course by getting approval from the relevant apex body of the university considering the SOP of the certificate course policies of the University. (iii) The institutes/college/departments can select more than one course out of the given sets of courses and offer them to their students. (iv) The students can select any of the courses offered by the institute/college/department from the given choices and enrol for the course. (v) The institute/college/department will arrange appropriate resource person(s) for the course. (vi) The course evaluation will be taken place at the college/institute/department level based on the nature of the course. (vii) The institute/college/department will assess the student based on the nature of the course. The student will be granted the credits on successful completion of the course.

Reference Books	- The reference materials and books will be decided by the Institutes/Colleges/Departments based on the selected Courses. - Minimum five copies of relevant topics are recommended to keep in the library.
Teaching Methodology	Class Work/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ field work and/or Assignments.
Evaluation Method	50% Internal assessment. 50% External assessment. Maximum Marks: 50

Course code: 307**Course Title: Indian Knowledge System in context to Computers – 01(VAC-03)****[Subject code-2611001503077001]**

Course Code	307
Course Title	Indian Knowledge System in context to Computers – 01 (VAC-03)
Credits	2 credits
Course Category	Value Added Course
Level of Course	100-199 (Fundamental Level)
Teaching per Week	1 Hours Theory + 2 Hours of Lab/interactive work.
Minimum weeks/Hours per Semester	15 Hours Theory + 30 Hours of Practical (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Cognitive Skills of the Course	The purpose of this course is to provide a comprehensive understanding of the Indian Knowledge System, particularly in the fields of Mathematics and Astronomy. It aims to explore the ancient texts and sutras, such as the Lilavati Samhita, Suryasiddhanta, and Shulba Sutras, highlighting their profound contributions to mathematical principles, geometric operations, and astronomical theories. The course also emphasizes the application of Vedic Mathematics and its mental calculation techniques. By studying these ancient texts and their innovative methods, students will gain a deeper appreciation for India's historical contributions to science and mathematics, fostering critical thinking and analytical skills in these domains. Remembering: 1. Recall key mathematical and astronomical concepts from ancient texts (e.g., Lilavati Samhita, Suryasiddhanta). 2. List important sutras from Vedic Mathematics and ancient astronomical theories. Understanding: 1. Explain the significance of ancient mathematical techniques and astronomical principles. 2. Describe the application of Vedic Mathematics sutras like Nikhilam and Ekadhikena Purvena. Application: 1. Solve arithmetic, algebraic, and geometric problems using ancient Indian methods. 2. Use astronomical principles from Suryasiddhanta to predict eclipses and planetary motion. Analysis: 1. Compare ancient methods with modern mathematical and astronomical techniques. 2. Analyze the influence of Indian astronomy on later scientific developments. Evaluation: 1. Critique the effectiveness of Vedic Mathematics in modern problem-solving. 2. Evaluate the accuracy of ancient astronomical calculations against modern findings. Creation: 1. Develop original problems using Vedic Mathematics sutras. 2. Design a modern application of ancient Indian astronomical principles (e.g., space exploration).
Course Objective	1. To explore the mathematical concepts and techniques from ancient Indian texts like Lilavati Samhita and Suryasiddhanta. 2. To understand the principles of Vedic Mathematics and its application in modern problem-solving.

	3. To analyze the contributions of ancient Indian astronomers like Aryabhata and Varahamihira in shaping early astronomical theories. 4. To examine the geometric and algebraic operations described in Shulba Sutras and their relevance to modern mathematics. 5. To develop a deeper appreciation for the richness and historical significance of the Indian Knowledge System in scientific advancements.										
Pre-requisite	Basic knowledge of English and Computer programming language (C/Python).										
Course Outcomes	CO1: To familiarize students with the ancient Indian mathematical concepts and techniques found in texts like Lilavati Samhita and Suryasiddhanta. CO2: To enable students to understand and apply Vedic Mathematics sutras for efficient problem-solving and mental arithmetic. CO3: To examine the contributions of Aryabhata and Varahamihira in ancient Indian astronomy and their impact on modern astronomical theories. CO4: To analyze the geometric and algebraic operations from the Shulba Sutras and explore their relevance in today's mathematical applications. CO5: To foster an appreciation for the historical and scientific significance of the Indian Knowledge System in shaping the development of mathematics and astronomy.										
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)			PSO 1	PSO2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	
	CO1										
	CO2										
	CO3										
	CO4										
	CO5										
	CO6										
Course Content	Unit-1 : Indian knowledge system of Mathematics : 1.1 Ancient Indian Arithmetic from Lilavati Samhita by Bhaskarachary-I: 1.1.1 Arithmetic rule : Sutra (Verse 1) 1.1.2 Multiplication of Large Numbers: Sutra (Verse 5) 1.1.3 Division: Sutra (Verse 8): Unit-2 : Ancient Algebra and its implementation 2.1 Ancient Algebra and Geometry operations from Lilavati Samhita: 2.1.1 Algebra : Sutra (Verse 13) 2.1.2 Geometric Relationships: Sutra (Verse 17) 2.1.3 Understanding Lilavati Samhita theorem later taught as Pythagorean theorem (Geometry): Sutra (Verse 23) [Implementation of all sutras in computer Lab. Using C / Python / Any other Prog. Language.] Unit-3 : Indian knowledge system on Astronomy : 3.1 Ancient Indian Astronomy from Suryasiddhanta by Aryabhata: 3.1.1 Motion of the Earth: Sutra (Verse 3.9) 3.1.2 Length of the Year : Sutra (Verse 3.10) 3.1.3 Lunar and Solar Eclipses: Sutra (Verse 4.5) 3.1.4 The Motion of Planets : Sutra (Verse 1.13) 3.1.5 The Influence of the Sun on Planetary Motion: Sutra (Verse 2.12) 3.1.6 Zodiac and Signs: Sutra (Verse 1.5) 3.1.7 Solar System: Sutra (Verse 1.15) 3.1.8 Speed of Planets: Sutra (Verse 6.5) 3.1.9 Planetary Distances from earth to moon: Sutra (Verse 7.8) 3.1.10 Latitude and Longitude of Planets : Sutra (Verse 8.12) Unit-4: Ancient Indian Astronomy and its Application: 4.1 Ancient Indian Astronomy by Varahmihir : 4.1.1 On Lunar Phases : Sutra (Verse 2.10) 4.1.2 On the Movements of the Stars : Sutra (Verse 2.18)										

	4.1.3 Ecliptic Latitude and Longitude 4.1.4 Sidereal and Tropical Years 4.1.5 Planetary Conjunctions and Aspects [Students will prepare a presentation on assigned topics and prepare a detailed report on given topic. Students will present the topic and submit the report as part of their final evaluation.]
Reference Books	1. "Vedic Mathematics", Bharati Krishna Tirthaji, Motilal Banarsidass Publishers, ISBN-13: 978-8170611552 2. "Lilavati", Bhaskaracharya (Bhaskara I), Oriental Publishers, ISBN-13: 978-8171101539 3. "Suryasiddhanta", Aryabhata, Motilal Banarsidass Publishers, ISBN-13: 978-8120818503 4. "The Shulba Sutras", J. L. Shastri, Motilal Banarsidass Publishers, ISBN-13: 978-8120817018 5. "A History of Ancient Indian Mathematics", S. N. Sen, Motilal Banarsidass Publishers, ISBN-13: 978-8120804247 6. "Mathematics in Ancient India", S. C. R. Anjaneyulu, Asia Publishing House, ISBN-13: 978-8120603404 7. "The Concept of Zero", Shukla S. K., M.D. Publications, ISBN-13: 978-8175332634 8. "Aryabhatiya of Aryabhata", Aryabhata, Varanasi: K. P. Jayaswal Research Institute, ISBN-13: 978-8185760255 9. "Indian Mathematics: History and Development", K. V. P. Subramanian, Springer, ISBN-13: 978-3319225829 10. "Indian Astronomy: A Study", M. A. Sastry, Cambridge University Press, ISBN-13: 978-0521270339
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. : - Attendance, Class and home Assignment, - Lab work based on Unit-1,3 and 4; - Report writing and report presentation based on Unit-2. 50% External assessment. : (i) Practical exam to implement given problem(s) based on Unit-1,Unit-3 and Unit-4. (ii) Presentation on report prepared during the semester based on Unit-2.

Internship: Student willing to exit the program at the end of the two semesters and to avail the Certificate in Computer Application or exit the program at the end of the first four semesters and to avail the Diploma in Computer Application, it is essential to acquire four credits from internship. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning. In option to these internships, the student can avail such four credits by availing two 2-credit university approved courses during any of these semesters. The student is required to enroll and avail these 4-credits and produce the evidence in process to opt the multi-level exit option after successfully completion of first year (two semester) or second year(four semesters).

Semester - 4**Course Code: 401****Course Title: Organizational Soft-skills in Software Industry**

Course Code	401
Course Title	Organizational Soft-skills in Software Industry Ability Enhancement Course – 04 [In option to this course, the course will be selected by the student and required 2 credits can be opted from the list of courses mentioned in Table-6 (Page number 51 – 52) from NEP-2020 S.O.P. of Gujarat State implementation handbook for NcrFr. The credits can be acquired through any valid MOOC, online courses recognized and approved by UGC or from courses offered by college/institute out of the course basket offered by the University under the Ability Enhancement courses]
Credits	2
Course Category	Ability Enhancement Course (AEC-04)
Level of Course	200-299 (Intermediate Level)
Teaching per Week	2 Hours
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Purpose of Course	Computer Science professionals work at different levels in the hierarchy of various jobs in IT. It is essential to understand the Organization Structure and behavior. - Integration of Knowledge and Skills: One objective of a multidisciplinary course is to foster the integration of knowledge and skills from different disciplines. By combining various areas of study, students can gain a holistic understanding of a particular topic or problem. This objective aims to break down the traditional boundaries between subjects and encourage students to see connections and relationships across different fields. - Promoting Critical Thinking and Problem Solving: Another objective is to enhance students' critical thinking and problem-solving abilities. Multidisciplinary courses often involve complex real-world issues that require a multifaceted approach. By engaging with diverse perspectives and methodologies, students develop the capacity to analyze problems from multiple angles, think creatively, and propose innovative solutions. - Enhancing Collaboration and Communication Skills: Collaboration and effective communication are essential skills in today's interconnected world. Multidisciplinary courses aim to cultivate these skills by providing opportunities for students to work collaboratively with peers from different disciplines. Through group projects, discussions, and presentations, students learn how to articulate their ideas, listen actively to others, and collaborate effectively to achieve common goals. This objective prepares students for interdisciplinary work environments and encourages the exchange of ideas across disciplinary boundaries.
Course Objective	These courses are designed as combination of Indian Languages (from the Eighth Schedule of the Indian Constitution) and English language courses, with a specific focus on enhancing language and communication skills. The primary objective of these courses is to help students acquire and demonstrate essential soft-skills in discipline specific (software industry), linguistics skills, including critical reading, expository writing and academic writing. HEIs have flexibility to introduce courses that are tailored to specific disciplines or are applicable across all undergraduate programmes. A list of a few AEC courses is provided in Table-6 (3.3.4) of Implementation of NEP-2020 for the

	state of Gujarat S.O.P.								
Pre-requisite	Knowledge of English at H.Sc.(10 th) Level								
Course Outcomes	CO1: After completion of the course the student will be aware about the Structure of an organization CO2: Also, will have better understanding of human Behaviour in an organization CO3: Students will understand and develop their attitude CO4: Students will learn the importance of motivation CO5: Students will be able to understand the leader, skills of leader and leadership styles CO6: students will have idea about BPO and call centers								
Mapping between Course Outcome(CO) and Program Specific Outcome (PSO):		PS01	PS02	PS03	PS04	PS05	PS06	PS07	PS08
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
	CO6								
Course Content	Unit 1: Introduction to Software development Organization Structure 1.1 What makes an organization 1.2 Overview of software organizational structure and its importance in software development 1.3 Structure of organization: 1.4 Traditional vs. Agile organizational structures in software development 1.5 Roles and responsibilities within software development teams 1.6 Management in Software Organization : Scope and Role of Management Unit 2: Writing Skills for Effective Communication in Organizations 2.1 Importance of writing skills in software organizations 2.2 Principles of effective written communication (clarity, conciseness, coherence) 2.3 Techniques for writing professional emails, reports, and documentation 2.4 Best practices for writing technical documents and user manuals in software development Unit-3 : Software Organizational Hierarchy and team building 3.1 Hierarchy in software development organization and roles of Project manager, System Analyst, System Architect, Business Model Developer, Team Leaders, Coders, Debuggers. 3.2 Managerial Skills (Technical Skills, Human Skills, Conceptual Skills) 3.3 Importance of verbal communication skills in software development teams 3.3.1 Effective communication in meetings, stand-ups, and presentations 3.3.2 Active listening techniques for better understanding and collaboration 3.3.3 Strategies for conveying technical concepts to non-technical stakeholders Unit 4: Communication Strategies for Collaboration 4.1 Importance of communication in team collaboration and project management. 4.2 Strategies for resolving conflicts and addressing disagreements in software teams. 4.3 Effective communication techniques for remote and distributed teams. 4.4 Building rapport and fostering team cohesion through effective communication practices.								

	4.5 Opportunities for automation, intelligent decision-making, and impact on software development teams.
Reference Books	1.) Title: "Software Engineering at Google: Lessons Learned from Programming Over Time", Author: Titus Winters, Tom Manshreck, Hyrum Wright, Publisher: O'Reilly Media, ISBN: 978-1492082798 2.) Title: "The Elements of Style", Author: William Strunk Jr., E.B. White, Publisher: Pearson, ISBN: 978-0205309023 3.) Title: "Writing That Works: How to Communicate Effectively in Business", Author: Kenneth Roman, Joel Raphaelson, Publisher: Harper Business, ISBN: 978-0060956431 4.) Title: "Technical Communication: A Reader-Centered Approach", Author: Paul V. Anderson, Publisher: Cengage Learning, ISBN: 978-1305667884 5.) Title: "Crucial Conversations: Tools for Talking When Stakes Are High", Authors: Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Publisher: McGraw-Hill Education, ISBN: 978-0071771320 6.) Title: "Nonviolent Communication: A Language of Life", Author: Marshall B. Rosenberg, Publisher: Puddledancer Press, ISBN: 978-1892005038. 7.) Title: "The Silent Language", Author: Edward T. Hall, Publisher: Anchor, ISBN: 978-0385055499 8.) Title: "Emotional Intelligence 2.0", Authors: Travis Bradberry, Jean Greaves, Publisher: TalentSmart, ISBN: 978-0974320625 9.) Title: "Leadership and Self-Deception: Getting Out of the Box", Authors: The Arbinger Institute, Publisher: Berrett-Koehler Publishers, ISBN: 978-1576759776 10.) Title: "Difficult Conversations: How to Discuss What Matters Most" Authors: Douglas Stone, Bruce Patton, Sheila Heen, Publisher: Penguin Books, ISBN: 978-0143118442.
Teaching Methodology	Class Work, Discussion, Self-Study, Case-study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment. External Assessment: Each student will be given a case-study of software industry to study organizational structure, hierarchy of the employee structure, environment and interpersonal communication among the teams. Tools and techniques used to interact within the organization and with the clients. The students will create a report/document based on the given case study and give presentation at the end of the semester for final evaluation. The examiner panel will consist of two examiners including one faculty member/resource person who handled the course and one person from the software industry. (Incase the person from software industry is not available, both examiners can be faculty members/resource person of the institute.) Assessment : - Writing skills and report/documentation abilities (20%) - Oral presentations evaluating verbal communication skills (20%) - Viva-voce (20%) - Case study analysis and problem-solving exercises focusing on communication strategies in software organizations (40%)



Course Code : 402 Course Title: Introduction to IoT (Internet of Things)	
Course Code	402
Course Title	Introduction to Internet of Things (IoT)
Credit	4
Course Category	Minor Course
Level of Course	200-299 (Intermediate Level)
Teaching per Week	4 Hrs
Minimum weeks per Semester	15 (Including Class work, examination, preparation etc.)
Last Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Medium of Instruction	English
Purpose of Course	The purpose of the "Introduction to IoT" course is to provide students with a foundational understanding of the Internet of Things (IoT) ecosystem. Through this course, students will gain insight into the concepts, technologies, and applications that underpin IoT networks and devices. They will explore the interconnected nature of IoT systems, learn about sensors, actuators, and connectivity protocols, and understand how data is collected, transmitted, and analyzed in IoT environments. Ultimately, the course aims to equip students with the knowledge and skills to comprehend the potential of IoT in various industries, and to critically evaluate IoT solutions for addressing real-world challenges.
Course Objective	To understand the concepts and protocols related to Internet of Things. To get an idea where the application areas are available for the Internet of Things to be applied.
Pre-requisite	Basic Knowledge of Networking
Course Out come	CO1: Understand the Concept of IoT: Students will be able to define the Internet of Things (IoT) and explain its significance in connecting physical devices, sensors, and actuators to the internet to enable data exchange and automation. CO2: Identify IoT Components and Technologies: Students will be able to identify and describe the key components of IoT systems, including sensors, actuators, microcontrollers, communication protocols, and cloud platforms. CO3: Explain IoT Communication Protocols: Students will be able to explain various communication protocols used in IoT networks, such as Wi-Fi, Bluetooth, Zigbee, and MQTT, and understand their strengths, weaknesses, and applications. CO4: Analyze IoT Applications and Use Cases: Students will be able to analyze real-world IoT applications and use cases across different industries, such as smart homes, healthcare, transportation, agriculture, and industrial automation. CO5: Design and Implement Simple IoT Solutions: Students will be able to design and implement simple IoT solutions using hardware components, microcontrollers, sensors, actuators, and basic programming languages. CO6: Evaluate IoT Security and Privacy Considerations: Students will be able to identify and assess security and privacy challenges in IoT

	systems, understand common vulnerabilities and threats, and explore strategies for securing IoT devices and data.								
Mapping between Course Outcomes (CO) and Program Specific Outcomes (PSO):		PS01	PS02	PS03	PS04	PS05	PS06	PS07	PS08
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
	CO6								
Course Content	Unit 1: Introduction to Internet of Things 1.1 Definition & Characteristics of IoT 1.2 Introduction to IoT Architecture 1.3 Physical Design of IoT 1.3.1 Things in IoT 1.3.2 IoT Protocols (Ethernet , WIFI , WIMAX, LR-WPAN(Wireless personal area network), 2G/3G/4G Mobile Communication, IPV6,6LOWPAN,MQTT, WEB SOCKET) 1.4 Logical Design of IoT 1.4.1 IoT Functional Blocks 1.4.2 IoT Communicational Models - Request – Response - Publish –Subscribe - Push –Pull - Exclusive Pair Unit 2. IoT and M2M 2.1 Introduction M2M 2.2 Introduction to Sensor Technology 2.3 Difference between IoT and M2M, 2.4 Security for IoT 2.5 IoT Enabling Technologies 2.5.1 Wireless Sensor Networks 2.5.2 Big Data Analytics, 2.5.3 Embedded Systems. Unit 3.Sensors and Actuators in IoT 3.1 Definition of Sensors 3.2 Types of sensors and its usage (Temperature, Humidity, Gas Detector, Ultrasonic, Fire detector, Light, Sound, IR, Water Level) 3.3 Introduction to Actuators 3.4 Types of Actuators 3.5 Difference between Sensors & Actuators Unit 4.Introduction to Raspberry pi and Arduiano 4.1 Introduction on IoT Devices 4.2 Basic Building blocks of an IoT Device 4.3 Introduction to Raspberry pi (Concepts, purpose, Application areas) 4.4 Components of Raspberry pi 4.5 Introduction to Arduiano (Concept, purpose and Application areas) 4.6 Difference between Raspberry pi and Arduiano 4.7 Case Study 4.7.1 IoT for Smart city applications 4.7.2 IoT for Smart Home 4.7.3 IoT for Health & Lifestyle								

Reference Books	1. Internet of Things , A Hands – On Approach, Arshdeep Bahga, Vijay Madisetti published by Arshdeep Bahga & Vijay Madisetti 2. Internet of Things architecture and Design Principles, Raj Kamal, McGrawhill Education private limited, 2017 3. Learning Internet of Things, Peter Waher, / Packt Publishing Limited, 2015 4. The Internet of Things, Hakima Chaouchi, Wiley,2017 5. Getting started with the Internet of Things: by CunoPfister, O”Reilly Media. 6. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press) 7. "Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications", Author: Adeel Javed, Publisher:Apress, ISBN:978-1484219393 8. "Understanding the Internet of Things: A Conceptual and Pragmatic Approach", Author: David Evans,Publisher: O'Reilly Media, ISBN: 978-1491924565 9. "Designing Connected Products: UX for the Consumer Internet of Things", Author: Claire Rowland, Elizabeth Goodman, Martin Charlier, and Ann Light, Publisher: O'Reilly Media, ISBN: 978-1449372569 10. "IoT Inc: How Your Company Can Use the Internet of Things to Win in the Outcome Economy", Author: Bruce Sinclair, Publisher:McGraw-Hill Education, ISBN: 978-1260025899
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. 50% External assessment. - Written Theory exam



Course Code: 403

Course Title: Object Oriented Programming with Java

Course Code	403																																																						
Course Title	Object Oriented Programming with Java																																																						
Credits	4																																																						
Course Category	Major Course																																																						
Level of Course	300-399 (Higher Level)																																																						
Teaching per Week	4 Hrs. (3 Hours Theory + 2 Hours Practical work)																																																						
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)																																																						
Review / Revision	-																																																						
Implementation Year:	A.Y. 2026-2027																																																						
Purpose of Course	To teach Object Oriented Programming (OOP) concepts through Coding using Java as programming language.																																																						
Course Objective	1. To make students understand the syntax and Object Oriented Programming (OOP) concepts using Java. 2. To make students understand various inbuilt Java classes and their working. 3. To make students understand the importance of OOP methodology. 4. To make students understand various types of OOP techniques.																																																						
Pre-requisite	Prior Knowledge object oriented concepts.																																																						
Course Outcomes	CO1: Understand the core principles of object-oriented programming (OOP) and apply them proficiently in Java, including classes, objects, inheritance, polymorphism, and encapsulation. CO2: Develop the ability to design, implement, and test Java applications, employing OOP concepts to create modular, reusable, and maintainable code. CO3: Demonstrate competence in utilizing Java's built-in libraries and frameworks to solve real-world problems efficiently, leveraging object-oriented design patterns where applicable. CO4: Analyze and debug Java programs effectively, employing best practices in error handling, exception handling, and debugging techniques to ensure robustness and reliability. CO5: Collaborate with peers in team-based Java projects, effectively communicating ideas, contributing to code reviews, and integrating individual contributions into cohesive software solutions.																																																						
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)	<table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	CO1									CO2									CO3									CO4									CO5								
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8																																															
CO1																																																							
CO2																																																							
CO3																																																							
CO4																																																							
CO5																																																							
Course Content	Unit 1: Introduction to Java 1.1 Features and properties of Java 1.2 Java vs. C++: Key differences in OOP approach 1.3 Java Development Tools: Compiler (javac), Interpreter (java) 1.4 Basic elements: Identifiers, Keywords, Data Types, Variables, Literals 1.5 Conditional Statements: if, if-else, switch 1.6 Loops: while, do-while, for 1.7 Type Casting: Implicit and Explicit casting Unit 2: Classes, Objects & Inheritance 2.1 Defining a class, creating objects																																																						

	2.2 Access modifiers (public, private, protected) 2.3 Constructors: Default and parameterized 2.4 Inheritance Basics: extends keyword 2.4.1 Method Overloading and Overriding, Encapsulation overview 2.5 this and super keywords with examples 2.6 Static members: variables, methods, and static blocks 2.7 Introduction to Interfaces 2.7.1 Declaring and implementing interfaces 2.7.2 Inheriting and overloading methods 2.7.3 Interface usage in real-world problems Unit 3: Strings and Exception Handling 3.1 Working with Strings 3.1.1 Comparing and manipulating strings 3.1.2 Common methods: length(), charAt(), concat(), equals(), substring() 3.1.3 Using StringBuffer for mutable strings 3.1.4 Basic StringBuffer methods: append(), insert(), delete(), reverse() 3.2 Introduction to Exception Handling 3.2.1 Types of exceptions: Checked and Unchecked 3.2.2 Handling exceptions using try, catch, finally 3.2.3 Custom (user-defined) exceptions 3.2.4 Using throw and throws keywords Unit 4: Multithreading and Packages 4.1 Threads in Java 4.1.1 Basics of Threading and Thread class 4.1.2 Thread priority and lifecycle (brief overview) 4.2 Java Packages 4.2.1 Defining and importing packages 4.2.2 Accessing package members 4.2.3 Using built-in packages (java.util, java.lang) 4.3 Basic Data Structures using Java 4.3.1 Using Classes to Implement Simple Data Structures 4.3.1.1 Concept of Linked Lists 4.3.1.2 Singly Linked List: Create, traverse, insert, delete 4.3.1.3 Circular Singly Linked List: Create and traverse (insertion/deletion can be simplified or optional)
Reference Books	1. Java Programming Language – Ken Arnold James Gosling, David Holmes: –Addison Wesley (Pearson Education) 2. Java – The complete reference, – Herbert Schildt: – Tata McGrawHill 3. Java 2 From Scratch: – Steven Haines: –PHI. 4. Programming in Java – E-Balaguruswamy: – Tata McGraw Hill 5. Java: How to Program: – Deitel & Deitel: – PHI
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course Code: 404

Course Title: Data Visualization using Intelligent Data Analytical Tool

[Subject code for Theory-2711001504022001] [Subject code for Practical-2711001504022002]

Course Code	404-07																																																						
Course Title	Data Visualization using Intelligent Data Analytical Tool																																																						
Credits	4																																																						
Course Category	Major Course																																																						
Level of Course	300-399 (Intermediate Level)																																																						
Teaching per Week	2 Hours Theory + 4 Hours Practical work																																																						
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)																																																						
Review / Revision	-																																																						
Implementation Year:	A.Y. 2026-2027																																																						
Purpose of Course	- The course is designed to introduce students to Power BI, a widely used business intelligence tool, with an emphasis on data loading, preparation, visualization, and report sharing. - It helps bridge the gap between basic programming knowledge and real-world data analytics by empowering students to create meaningful and interactive dashboards and reports from raw datasets.																																																						
Course Objective	1. To understand the ecosystem and interface of Power BI. 2. To clean and transform data using Power Query Editor. 3. To create and format effective visualizations for data storytelling. 4. To design interactive dashboards and multi-page reports. 5. To publish and share reports using Power BI Service.																																																						
Pre-requisite	- Fundamental Python programming (data types, loops, functions) - Basic knowledge of Pandas for data cleaning - Understanding of SQL commands (SELECT, JOIN, GROUP BY) - Comfort with CSV/Excel file formats and basic file handling																																																						
Course Outcomes	CO1: <i>Describe</i> the concepts of Business Intelligence and the Power BI ecosystem, including its tools, lifecycle, and interface. CO2: <i>Apply</i> data connection and transformation techniques using Power Query to prepare and clean datasets from various sources. CO3: <i>Construct</i> basic data models by creating relationships, calculated columns, and measures to enable efficient data analysis. CO4: <i>Develop</i> interactive visualizations and dashboards using different chart types, slicers, filters, and formatting features in Power BI. CO5: <i>Evaluate</i> and <i>publish</i> Power BI reports to the Power BI Service by implementing best practices in design, interactivity, and sharing.																																																						
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)	<table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	CO1									CO2									CO3									CO4									CO5								
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CO1																																																							
CO2																																																							
CO3																																																							
CO4																																																							
CO5																																																							
Course Content	UNIT-1: Power BI Basics – Interface and Data Loading 1.1 Introduction to Business Intelligence (BI) 1.1.1 Understanding Power BI 1.1.2 Role of BI in organizations 1.1.3 Benefits of using BI tools 1.2 Power BI Ecosystem 1.2.1 Power BI Desktop, Service, and Mobile																																																						

	1.2.2 Installation of Power BI Desktop 1.2.3 Advantages and disadvantages 1.3 BI Lifecycle and Workflow 1.3.1 From data to dashboard: BI pipeline 1.3.2 Understanding project flow 1.4 Power BI Desktop Interface 1.4.1 Report View 1.4.2 Data View 1.4.3 Model View 1.5 Data Connections 1.5.1 Why Data connections require? 1.5.2 Connecting to Excel, CSV, Web, SQL data sources UNIT-2: Power Query – Data Preparation and Cleaning 2.1 Power Query Editor 2.1.1 Introduction to Power Query 2.1.2 Connecting to data sources (CSV, Excel, Web, SQL) 2.1.3 Managing tables and query settings 2.2 Data Profiling and Cleaning Techniques 2.2.1 Column statistics and distribution 2.2.2 Removing nulls, filtering rows 2.2.3 Splitting/merging columns 2.2.4 Changing data types 2.2.5 Replacing, trimming, cleaning text 2.3 ETL Concepts in Power BI 2.3.1 What is ETL? 2.3.2 Overview of Extract, Transform, Load process 2.4 Query Operations and M Language (Intro) 2.4.1 Appending and merging queries 2.4.2 Overview of M language (concept only) UNIT-3: Basic Data Modelling and Relationships 3.1 Concepts of Data Modelling 3.1.1 What is Data model? 3.1.2 Tables Vs Relationships 3.1.3 Normalization and denormalization 3.2 Creating Relationships 3.2.1 Primary/foreign keys 3.2.2 One-to-many, many-to-one 3.2.3 Cardinality and cross-filter direction 3.3 Calculated Columns and Measures (Basics) 3.3.1 When to use calculated columns 3.3.2 Creating simple formulas 3.3.3 Conceptual difference: columns vs. measures 3.4 Categorization and Sorting 3.4.1 Sorting by columns 3.4.2 Data categories for mapping and hierarchy UNIT-4: Practical Applications and Hands-on Reporting (Suggested Expansion) 4.1 Building Basic Reports 4.1.1 Creating tables and visuals 4.1.2 Applying filters and slicers 4.2 Visualization Best Practices 4.2.1 Choosing chart types 4.2.2 Formatting visuals
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	4.3 Publishing and Sharing Reports 4.3.1 Saving and publishing to Power BI Service 4.3.2 Exporting reports to PDF/PPT 4.4 Intro to Dashboards and Tiles 4.4.1 Pinning visuals 4.4.2 Creating a basic dashboard
Reference Books	1. <i>Power BI Data Analysis and Visualization</i>, Suren Machiraju, Manoj Joseph, PHI Learning, India, ISBN: 9788120353131 2. <i>Business Intelligence: Concepts, Tools and Applications</i>, V. K. Jain, Khanna Publishing, India, ISBN: 9789382609752 3. <i>Power BI for Beginners</i>, Chandraish Sinha, BPB Publications, India, ISBN: 9789389898784 4. <i>Business Analytics: The Science of Data-Driven Decision Making</i>, U. Dinesh Kumar, Wiley India, ISBN: 9788126565095 5. <i>BI Made Easy Using Power BI</i>, A. S. Thakur, Tech Knowledge Publications, India, ISBN: 9789390620714 6. <i>Mastering Microsoft Power BI</i>, Brett Powell, Packt Publishing, ISBN: 9781788297230 7. <i>Microsoft Power BI Quick Start Guide</i>, Devin Knight et al., Packt Publishing, ISBN: 9781789805793 8. <i>Applied Microsoft Power BI</i>, Teo Lachev, Prologika Press, ISBN: 9780976635385 9. <i>Introducing Microsoft Power BI</i>, Alberto Ferrari, Marco Russo, Microsoft Press, ISBN: 9781509306978 10. <i>Power BI Cookbook</i>, Greg Deckler, Packt Publishing, ISBN: 9781800205697
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course Code: 405**Course Title: Fundamentals of Machine Learning**

[Subject code for Theory-2711001504033001] [Subject code for Practical-2711001504033002]

Course Code	405								
Course Title	Fundamentals of Machine Learning								
Credits	4								
Course Category	Major Course								
Level of Course	300-399 (Intermediate Level)								
Teaching per Week	2 Hours Theory + 4 Hours Practical work								
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)								
Review / Revision	-								
Implementation Year:	A.Y. 2026-2027								
Purpose of Course	This course aims to introduce students to the fundamental principles of Machine Learning (ML), covering its core concepts, types, algorithms, and practical implementation. It lays the groundwork for understanding how machines learn from data and make intelligent decisions, preparing learners for more advanced topics in data science, artificial intelligence, and deep learning.								
Course Objective	1. Understand the relationship between Artificial Intelligence, Machine Learning, Deep Learning, and Data Science. 2. Identify and describe different types of Machine Learning paradigms: supervised, unsupervised, and reinforcement learning. 3. Gain knowledge of real-world ML applications and challenges. 4. Learn and implement common supervised learning algorithms like Linear Regression, Decision Trees, Random Forests, Logistic Regression, and KNN. 5. Evaluate ML models using appropriate performance metrics. 6. Understand concepts like overfitting, underfitting, bias-variance tradeoff, and model validation techniques. 7. Develop and deploy basic ML models using Python's scikit-learn library.								
Pre-requisite	Basic proficiency in Python programming (variables, loops, functions, basic libraries like NumPy or Pandas). Fundamental knowledge of statistics and mathematics, particularly linear algebra and probability. Familiarity with basic data handling and visualization.								
Course Outcomes	CO1: Differentiate between AI, ML, Deep Learning, and Data Science, and identify the domains and applications of AI. CO2: Describe the types of machine learning approaches and their use cases. CO3: Understand and apply core ML concepts including datasets, features, labels, training/testing, overfitting, and underfitting. CO4: Build and evaluate regression models using Linear Regression, Decision Tree, and Random Forest. CO5: Implement and compare classification models using Logistic Regression, K-Nearest Neighbours, and Decision Trees.								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								

Course Content	UNIT 1: Introduction to Machine Learning 1.1 What is Machine Learning? 1.1.1 Definition and Scope 1.1.2 Difference between AI, ML, and Deep Learning 1.1.3 Real-life applications of ML (healthcare, finance, recommendation systems, etc.) 1.2 Types of Machine Learning 1.2.1 Supervised Learning 1.2.2 Unsupervised Learning 1.2.3 Reinforcement Learning (basic idea only) 1.3 Basic ML Terminology 1.3.1 Dataset, Features, Labels 1.3.2 Training set, Test set 1.3.3 Model, Prediction, Accuracy, Overfitting 1.4 Tools and Environment 1.4.1 Introduction to Python for ML 1.4.2 Installing and using Jupyter Notebook 1.4.3 Introduction to ML libraries: NumPy, Pandas, Scikit-learn (overview only) UNIT 2: Data Handling and Preprocessing 2.1 Data Collection and Loading 2.1.1 Loading CSV/Excel files in Python 2.1.2 Viewing and understanding the structure of a dataset 2.2 Data Cleaning 2.2.1 Handling missing values 2.2.2 Removing duplicates 2.2.3 Basic data type conversions 2.3 Data Preprocessing 2.3.1 Feature scaling: normalization and standardization 2.3.2 Label encoding and one-hot encoding (basics) 2.3.3 Train-test split using scikit-learn 2.4 Data Exploration (EDA – Basic Level) 2.4.1 Summary statistics (mean, median, mode, std) 2.4.2 Visualizations: histogram, scatter plot, bar chart using matplotlib/seaborn 2.4.3 Correlation matrix UNIT 3: Regression and Classification Techniques 3.1 Linear Regression 3.1.1 Concept of line fitting 3.1.2 Cost function and model evaluation (MSE, R^2 Score) 3.1.3 Linear regression using scikit-learn 3.2 Logistic Regression 3.2.1 Concept of classification and sigmoid function 3.2.2 Confusion matrix, accuracy, precision, recall 3.2.3 Logistic regression with scikit-learn UNIT 4: Basic ML Algorithms and Evaluation 4.1 K-Nearest Neighbors (KNN) 4.1.1 Concept and working of KNN 4.1.2 Distance metric (Euclidean distance) 4.1.3 Implementing KNN using scikit-learn 4.2 Model Evaluation (Basics) 4.2.1 Cross-validation 4.2.2 Accuracy vs Overfitting 4.2.3 Importance of clean and balanced datasets
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Reference Books	1. <i>Machine Learning (For Beginners)</i>, U Dinesh Kumar, Wiley India, ISBN: 9788126579956 2. <i>Introduction to Machine Learning</i>, Ethem Alpaydin, PHI Learning (India Edition), ISBN: 9788120350780 3. <i>Artificial Intelligence and Machine Learning</i>, Prateek Joshi, BPB Publications (India), ISBN: 9789386551934 4. <i>Machine Learning with Python</i>, Abhishek Vijayvargia, BPB Publications (India), ISBN: 9789387284497 5. <i>Machine Learning using Python</i>, Manaranjan Pradhan & U Dinesh Kumar, Wiley India, ISBN: 9788126579901 6. <i>Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow</i>, Aurélien Géron, O'Reilly Media, ISBN: 9789355423317 7. <i>Python Machine Learning</i>, Sebastian Raschka, Packt Publishing, ISBN: 9781801819312 8. <i>Machine Learning Yearning</i>, Andrew Ng, DeepLearning.ai, ISBN: 9781976800497 9. <i>Pattern Recognition and Machine Learning</i>, Christopher M. Bishop, Springer, ISBN: 9780387310732 10. <i>Introduction to Machine Learning with Python</i>, Andreas C. Müller & Sarah Guido, O'Reilly Media, ISBN: 9781449369415
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Written Theory exam - Practical Exam, viva-voce

Course code: 406
Course Title: Skill Enhancement Course (SEC-04)

Course Code	406
Course Title	Skill Enhancement Course - IV (SEC – 04)
Credit	2
Category of Course	Skill Enhancement Course
Level of Course	200-299 (Intermediate)
Teaching per Week	2 Hrs (Any or Combination of Theory/Practical/Fieldwork/Internship/Project)
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2024-2025
Purpose of Course	- As per NEP(National Education Policy-2020), it is mandatory for students to select a 2 credit Skill Enhancement Course out of the choices given by the college/institute. - It will be mandatory for the student to opt minimum one 2-credit Skill Enhancement Course from the course baskets of Skill Enhancement courses approved by the university or from any recognized MOOC or from recognised university through online mode subject to transfer of credit through ABC during semester-1 to semester-5. - The student can start an alternative career in the field by obtaining higher degree of knowledge in the area. - It's aimed at imparting practical skills, embedded internship, hands-on training, soft skills, life skills, such approved online courses etc. to enhance the employability of students. This may also include courses as per the need of new evolving technology.
Course Objective	Obtaining skill in particular field along with the regular curriculum of the selected program is essential. It not only enhance the skill but also provide an opportunity to develop skill in particular area where one can pursue career in future. Skill enhancement provides the opportunity and knowledge for an individual to develop and strengthen the necessary skills to gain, maintain, and advance in a chosen area. Skill enhancement programs are focused around training that combines the best practices from varieties of areas as described in NEP-2020 SOP by Gujarat State Higher education Department's SOP. Skill enhancement or training typically uses a combination of cognitive and behaviour problem solving approaches, both of which are used to strengthen a person's positive skill develop.
Pre-requisite	-
Course Content and Implementation road-map.	(i) University has categorised and prepared the basket of the courses including approved online courses that can be offered as Skill Enhancement Course. (ii) The institute/college/department can design and implement skill enhancement course by getting approval from the relevant apex body of the university considering the SOP of the certificate course policies of the University. (iii) The institutes/college/departments can select more than one course out of the given sets of courses and offer them to their students. (iv) The students can select any of the courses offered by the institute/college/department from the given choices and enrol for the course. (v) The institute/college/department will arrange appropriate resource person(s) for the course. (vi) The course evaluation will be taken place at the college/institute/department level based on the nature of the course.

	(vii) The institute/college/department will assess the student based on the nature of the course. The student will be granted the credits on successful completion of the course.
Reference Books	- The reference materials and books will be decided by the Institutes/Colleges/Departments based on the selected Courses. - Minimum five copies of relevant topics are recommended to keep in the library.
Teaching Methodology	Class Work/ Discussion/ Self-Study/ Seminars/ field works/ practical training/ field work and/or Assignments.
Evaluation Method	50% Internal assessment. 50% External assessment. (Evaluation and Assessment will be carried out based on the nature of the course. On successful completion of the course, the student will be granted 2 credits.)

Course code: 407

Course: Value Addition Course-IV (VAC-04)

Course Title: Indian Knowledge System in context to Computers - 02

[Subject code-27110015040770011]

Course Code	407
Course Title	Indian Knowledge System in context to Computers – 02
Credits	2 credits
Course Category	Value Added Course
Level of Course	100-199 (Fundamental Level)
Teaching per Week	1 Hours Theory + 2 Hours of Lab/interactive work.
Minimum weeks/Hours per Semester	15 Hours Theory + 30 Hours of Practical (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2026-2027
Cognitive Skills of the Course	The purpose of this course is to provide a comprehensive understanding of the Indian Knowledge System, particularly in the fields of Mathematics and Astronomy. It aims to explore the ancient texts and sutras, such as the Lilavati Samhita, Suryasiddhanta, and Shulba Sutras, highlighting their profound contributions to mathematical principles, geometric operations, and astronomical theories. The course also emphasizes the application of Vedic Mathematics and its mental calculation techniques. By studying these ancient texts and their innovative methods, students will gain a deeper appreciation for India's historical contributions to science and mathematics, fostering critical thinking and analytical skills in these domains. Remembering: 1. Recall key mathematical and astronomical concepts from ancient texts (e.g., Lilavati Samhita, Suryasiddhanta). 2. List important sutras from Vedic Mathematics and ancient astronomical theories. Understanding: 1. Explain the significance of ancient mathematical techniques and astronomical principles. 2. Describe the application of Vedic Mathematics sutras like Nikhilam and Ekadhikena Purvena. Application: 1. Solve arithmetic, algebraic, and geometric problems using ancient Indian methods. 2. Use astronomical principles from Suryasiddhanta to predict eclipses and planetary motion. Analysis: 1. Compare ancient methods with modern mathematical and astronomical techniques. 2. Analyze the influence of Indian astronomy on later scientific developments. Evaluation: 1. Critique the effectiveness of Vedic Mathematics in modern problem-solving. 2. Evaluate the accuracy of ancient astronomical calculations against modern findings. Creation: 1. Develop original problems using Vedic Mathematics sutras. 2. Design a modern application of ancient Indian astronomical principles (e.g., space exploration).
Course Objective	6. To explore the mathematical concepts and techniques from ancient Indian texts like Lilavati Samhita and Suryasiddhanta. 7. To understand the principles of Vedic Mathematics and its application in modern problem-solving.

	8. To analyze the contributions of ancient Indian astronomers like Aryabhata and Varahamihira in shaping early astronomical theories. 9. To examine the geometric and algebraic operations described in Shulba Sutras and their relevance to modern mathematics. 10. To develop a deeper appreciation for the richness and historical significance of the Indian Knowledge System in scientific advancements.									
Pre-requisite	Basic knowledge of English and Computer programming language (C/Python).									
Course Outcomes	CO1: To familiarize students with the ancient Indian mathematical concepts and techniques found in texts like Lilavati Samhita and Suryasiddhanta . CO2: To enable students to understand and apply Vedic Mathematics sutras for efficient problem-solving and mental arithmetic. CO3: To examine the contributions of Aryabhata and Varahamihira in ancient Indian astronomy and their impact on modern astronomical theories. CO4: To analyze the geometric and algebraic operations from the Shulba Sutras and explore their relevance in today's mathematical applications. CO5: To foster an appreciation for the historical and scientific significance of the Indian Knowledge System in shaping the development of mathematics and astronomy.									
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)			PSO 1	PSO2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
	CO6									
Course Content	Unit-1: Principles of Mathematics, Geometry and Triangles in Ancient Indian Knowledge: 1.1 Principles of Mathematics by Aryabhata. 1.1.1 Principles of Mathematics: Sutra (Verse 1.1) 1.1.2 Value of Pi: Sutra (Verse 3.1) 1.1.3 Sine Function: Sutra (Verse 3.2) 1.1.4 Trigonometric Functions: Sutra (Verse 3.11) Unit-2: Ancient knowledge From the Shulba Sutras: 2.1 Ancient knowledge From the Shulba Sutras (a part of Vedic texts): 2.1.1 Construction of a square 2.1.2 The original version of current Pythagorean theorem (Sulbha Sutra 1.2) 2.1.3 Area of Circle 2.1.4 Area of Triangle 2.2 Ancient knowledge by Brahmgupta : 2.2.1 Area of Cyclic Quadrilateral. (Sutra(verse-10)) [Implementation of all sutras of Unit-1 and 2 in computer Lab. Using C / Python / Any Prog.Language] Unit-3 : Vedic Mathematics Sutras : 3.1 Nikhilam Navatashcaramam Dashatah : "All from 9 and the last from 10." 3.2 Ekadhikena Purvena : "By one more than the previous one." 3.3 Udharan : "The extraction." 3.4 Paraavartya : "Transposition and cancellation." 3.5 Shunyam Saamyasamuccaye : "When the sum is the same that sum is zero." 3.6 Anurupyena : "Proportionately." 3.7 Sankalana-Vyavakalanabhyam : "By addition and by subtraction." Unit-4 : Advance Vedic Mathematics Sutras :									

	4.1 Puranapurāṇabhyāsa : "By the completion or non-completion." 4.2 Chālāna-Kālāna : "By motion or by applying a shift." 4.3 Yavādunam : "Whatever is the deficiency." 4.4 Vyastisamanstih : "The parts and the whole." 4.5 Sesānya : "The remainder." 4.6 Gunitasamuchyah : "The product of the sum." 4.7 Vistarāna : "Expansion." 4.8 Rūpa : "Form." 4.8.1 Chidāna : "By splitting." [Implementation of all sutras of Unit-3 and 4 in computer Lab. Using C / Python / Any Prog. Language]
Reference Books	1. "Vedic Mathematics", Bharati Krishna Tirthaji, Motilal Banarsidass Publishers, ISBN-13: 978-8170611552 2. "Lilavati", Bhaskaracharya (Bhaskara I), Oriental Publishers, ISBN-13: 978-8171101539 3. "Suryasiddhanta", Aryabhata, Motilal Banarsidass Publishers, ISBN-13: 978-8120818503 4. "The Shulba Sutras", J. L. Shastri, Motilal Banarsidass Publishers, ISBN-13: 978-8120817018 5. "A History of Ancient Indian Mathematics", S. N. Sen, Motilal Banarsidass Publishers, ISBN-13: 978-8120804247 6. "Mathematics in Ancient India", S. C. R. Anjaneyulu, Asia Publishing House, ISBN-13: 978-8120603404 7. "The Concept of Zero", Shukla S. K., M.D. Publications, ISBN-13: 978-8175332634 8. "Aryabhatiya of Aryabhata", Aryabhata, Varanasi: K. P. Jayaswal Research Institute, ISBN-13: 978-8185760255 9. "Indian Mathematics: History and Development", K. V. P. Subramanian, Springer, ISBN-13: 978-3319225829 10. "Indian Astronomy: A Study", M. A. Sastry, Cambridge University Press, ISBN-13: 978-0521270339
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. : - Attendance, Class and home Assignment, - Lab work based on Unit-1,3 and 4; - Report writing and report presentation based on Unit-2. 50% External assessment. : (iii) Practical exam to implement given problem(s) based on Unit-1,Unit-3 and Unit-4. (iv) Presentation on report prepared during the semester based on Unit-2.

Internship: Student willing to exit the program at the end of the two semesters and to avail the Certificate in Computer Application or exit the program at the end of the first four semesters and to avail the Diploma in Computer Application, it is essential to acquire four credits from internship. A key aspect of the internship is induction into actual work situations. Internships involve working with local industry, government or private organizations, business organizations, artists, crafts persons, and similar entities to provide opportunities for students to actively engage in on-site experiential learning. In option to these internships, the student can avail such four credits by availing two 2-credit university approved courses during any of these semesters. The student is required to enroll and avail these 4-credits and produce the evidence in process to opt the multi-level exit option after successfully completion of first year (two semester) or second year(four semesters).



Guidelines for Question paper style

- 1) Ideally each unit of the course should carry equal weightage of marks. However, it will vary upon the content of the units of the course.**
- 2) The major and minor course's question papers will be either 50 marks(2 hours duration) or 25 marks(1 hours of duration) for exams.**
- 3) The objective of the written/theory exams for all courses are to analyze the student's understanding about the course contents, assessing the conceptual knowledge about the course contents and ability to explain the concepts in written forms.**
- 4) As the practical exams are conducted separately and viva-voce is also a part of the practical exam, the concepts and practical knowledge can be analyzed through the practical exams.**
- 5) Since the subjects/courses are technical in nature, the major objective is to evaluate conceptual and technical knowledge for major and minor courses instead of expecting student's ability to write lengthy literature writing skills and abilities.**
- 6) 20% of questions are recommended to ask from objective/short questions/MCQ types having weightage of 1 to 2 marks per question. Purpose of such question is to analyze precise understanding for the topics/points/concepts.**
- 7) 30% of questions are expected to ask from short questions to answer in few lines having weightage of 3 to 4 marks. Purpose of such questions are to analyze conceptual understanding for the topics/points/concepts that can be describe in short.**
- 8) 50% of questions are expected to ask from long/descriptive/Short-notes questions to answer using charts/graphs/block diagrams/flowcharts/models having weightage of 5 to 7 marks. Purpose of such questions are to analyze the depth knowledge and ability to explain in detail emphasizing technical knowledge.**
- 9) The evaluation by the examiner is expected to evaluate overall technical understanding of the student, ability to express the technical and conceptual knowledge, clarity of thoughts and understanding of the subject and concepts.**



Re-Accredited 'B++' 2.86 CGPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

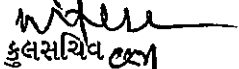
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-: પરિપત્ર :-

યુનિવર્સિટી સંલગ્ન કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની તમામ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૬-૨૭ થી અમલમાં આવનાર સ્નાતક કક્ષાના વિવિધ વિષયોના સેમેસ્ટર-૧, ૩, ૪ અને ૫ ના Skill Enhancement Course (SEC)ના પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમો કોમ્પ્યુટર સાયન્સ વિષય ની અભ્યાસ સમિતિના ચેરમેનશ્રીએ અભ્યાસ સમિતિવતી અને કોમ્પ્યુટર સાયન્સ ફેકલ્ટીના ઈ.ચા.ડીનશ્રીએ ફેકલ્ટીવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૭/૦૫/૨૦૨૬ ની સભાનાં ઠરાવ ક્રમાંક: ૬૬ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક:ઓથો./પરિપત્ર/૧૦૦૮૧/૨૦૨૬
તા.૧૨/૦૫/૨૦૨૬


કુલસચિવ

પ્રતિ,

- ૧) યુનિવર્સિટી સંલગ્ન તમામ કોમ્પ્યુટર સાયન્સ કોલેજોના આચાર્યશ્રીઓ.
.....આપશ્રીની કોલેજના સંબંધિત શિક્ષકો/વિદ્યાર્થીને જાણ કરી અમલ કરવા સારું.
- ૨) ઈ.ચા.ડીનશ્રી, કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા.
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારું.

SKILL ENHANCMENT COURSE (SEC)

FOR

**SEM-1 , SEM-2, SEM-3, SEM-4 AND
SEM-5**

FOR

**B.C.A. , B.SC.(COMPUTER SCIENCE),
B.SC.(C.A.), B.VOC.(I.T.) AND**

ALL B.C.A. SPECIALISED PROGRAMS (
A.I.& DATA ANALYTICS, DATASCIENCE,
CYBER SECURITY)
B.Sc. (Data Science)

SEMESTER- 3

Course Title: EDA using Python

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)/B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-01								
Course Level	200-299								
Course Title	EDA using Python								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
CourseOutcomes	1. Understand different types of data and sources 2. Identify and handle data errors effectively 3. Use Python libraries for data cleaning and analysis 4. Create meaningful visualizations 5. Perform complete EDA on real-world datasets								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Data and Data Sources 1.1 Types of Data 1.1.1 Structured, Semi-structured, and Unstructured Data 1.1.2 Qualitative vs Quantitative Data 1.1.3 Discrete vs Continuous Data 1.1.4 Time-series and Cross-sectional Data 1.2 Data Sources 1.2 .1 Primary vs Secondary Data 1.2.2 Open data sources (government portals, APIs) 1.2.3 Web scraping basics 1.3 Types of Databases 1.3.1Relational Databases (RDBMS) 1.3.2 NoSQL Databases (MongoDB, Cassandra) 1.3.3 Data Warehouses and Data Lakes 1.3 Types of Data Files 1.4.1 CSV, Excel, JSON, XML, TXT 1.4.2. Differences and use cases 1.4.3 File handling basics in Python 1.5 Introduction to Python for EDA 1.5.1 Python environment setup (Anaconda/Jupyter Notebook) 1.5.2 Basic syntax and data structures (lists, dictionaries, tuples)								

Unit 2: Data Quality, Errors, and Cleaning

2.1 Common Errors in Data

- 2.1.1 Missing values (NaN, NULL)
- 2.1.2 Duplicate data
- 2.1.3 Inconsistent formats (date, text, units)
- 2.1.4 Outliers and noise
- 2.1.5 Typographical errors

2.2 Disadvantages of Poor Data Quality

2.3 Importance of Data Cleaning

2.4 Data Cleaning Techniques

- 2.4.1 Handling missing values (imputation, deletion)
- 2.4.2 Removing duplicates
- 2.4.3 Data type conversion
- 2.4.4 String cleaning and formatting
- 2.4.5 Outlier detection and treatment

Unit 3: Python Libraries for Data Cleaning and Analysis

3.1 Introduction to Key Libraries

- 3.1.1 NumPy (numerical operations)
- 3.1.2 Pandas (data manipulation)

3.2 Pandas Functions for Data Cleaning

- 3.2.1 read_csv(), read_excel()
- 3.2.2 info(), describe()
- 3.2.3 isnull(), dropna(), fillna()
- 3.2.4 duplicated(), drop_duplicates()
- 3.2.5 astype()
- 3.2.6 apply(), map()

3.3 Data Transformation

- 3.3.1 Filtering and sorting data
- 3.3.2 Grouping (groupby())
- 3.3.3 Merging and joining datasets
- 3.3.4 Feature creation and modification

3.4 Introduction to Data Analysis

- 3.4.1 Descriptive statistics
- 3.4.2 Correlation and covariance
- 3.4.3 Aggregation techniques

Unit 4: Data Visualization Techniques in Python

4.1 Importance of Data Visualization

4.2 Visualization Libraries

- 4.2.1 Matplotlib
- 4.2.2 Seaborn
- 4.2.3 Plotly (basic introduction)

4.3 Types of Visualizations

- 4.3.1 Line charts
- 4.3.2 Bar charts
- 4.3.3 Histograms
- 4.3.4 Scatter plots
- 4.3.5 Box plots
- 4.3.5 Heatmaps

Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	<i>Python for Data Analysis</i>	Wes McKinney	O'Reilly Media	978-1491957660
	2	<i>Data Science from Scratch</i>	Joel Grus	O'Reilly Media	978-1492041139
	3	<i>Practical Statistics for Data Scientists</i>	Peter Bruce, Andrew Bruce	O'Reilly Media	978-1492072942
	4	<i>Hands-On Data Analysis with Pandas</i>	Stefanie Molin	Packt Publishing	978-1789615326
	5	<i>Data Wrangling with Python</i>	Jacqueline Kazil, Katharine Jarmul	O'Reilly Media	978-1491948811
	6	<i>Python Data Science Handbook</i>	Jake VanderPlas	O'Reilly Media	978-1491912058
	7	<i>Think Stats</i>	Allen B. Downey	O'Reilly Media	978-1491907337
	8	<i>Introduction to Data Science</i>	Laura Igual, Santi Seguí	Springer	978-3319500164
	9	<i>Applied Data Science with Python</i>	Alex Galea	Packt Publishing	978-1786468253
	10	<i>Mastering Pandas</i>	Femi Anthony	Packt Publishing	978-1789343236
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments				
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level				

Course Code: 306-02
Course Title: Fundamentals of Android

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	4.5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-02								
Course Level	200 - 299								
Course Title	Fundamentals of Android								
Credit	2 (2 Theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	CO1 : Explain Android architecture, features, and application framework. CO2 : Develop simple Android applications using Android Studio and basic knowledge of XML CO3 : Design user interfaces using various layouts and widgets. CO4 : Implement event handling for UI components like buttons and checkboxes. CO5 : Create interactive applications using dialogs, list views, and image views. Use intents to navigate between different application components.								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit - 1: Android OS Architecture & Features 1.1 History, concepts and Features of Android 1.2 Concepts of API framework 1.3 Kernel Native Libraries& DVM (Dalvik Virtual Machine) 1.4 Application Framework Unit – 2: XML Introduction 2.1 Characteristics of XML 2.2 XML Declaration, Tags and elements 2.3 Root element 2.4 XML documents Unit - 3: Android widgets and its implementation 3.1 First Android Project 3.2 Title Bar 3.3 Screen Orientation (Portrait, Landscape) 3.4 Android Layouts 3.4.1 Constraint Layout 3.4.2 Linear Layout 3.4.3 Table Layout 3.4.4 Grid View 3.5 Text Field, Button, Checkbox, Radiobutton 3.5.1 Event Handling on Button, Checkbox, Radiobutton								

	3.6 ToggleButton 3.7 Toast Unit - 4: Android Widgets 4.1 Alert Dialog Box 4.2 List View 4.3 Custom Listview 4.4 ImageView, Image Slider 4.5 Search View 4.6 Intent
Reference Books	1) Android Programming for Beginners - Second Edition, Author: John Horton, Publisher: Image Short ISBN: 978-1789538502 2) Android 9 Development Cookbook, Author: Rick Boyer, Publisher: Packet Publishing, ISBN: 978-1788991216 3) Android Application Development (With Kitkat Support), Author: Pradeep Kothari, Publisher: DreamTech Press., ISBN: 978-9351194095 4) Android Studio 4.0 Development Essentials – Kotlin Edition, Author – Neil Smyth, Publisher: Payload Media, ISBN – 13: 978 – 1951442194 5) Head First Android Development - 3rd Edition, Author: Dawn Griffiths, David Griffiths, Publisher: O'Reilly Media, ISBN: 9781492076522 6) Android Application Development Black Book, Author: Pradeep Kothari, Publisher: Dreamtech Press, ISBN: 9789351194095 7) Professional Android (4th Edition), Author: Reto Meier, Ian Lake, Publisher: Wiley, ISBN: 9781118949527 8) Programming Android: Java Programming for the New Generation of Mobile Devices, Author: Zigurd Mednieks, Publisher: O'Reilly Media, ISBN: 9781449316648 9) Learning Android Application Development, Author: Wallace Jackson, Publisher: Apress, ISBN: 9781484217848 10) Beginning Android Programming with Android Studio, Author: Jerome (J.F.) DiMarzio, Publisher: Wiley, ISBN: 9781118705598
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

Course Code: 306-03

Course Title: Fundamentals of Graphic Design with designing software

[illegible]

Course content	Unit 1: Introduction 1.1 What is Graphics Design? 1.2 Applications of Graphics Design 1.3 Basic shapes of Graphics 1.4 Overview of Canva 1.5 Exploration of Canva Dashboard Unit 2: Canva Editing Basics and Social Media 2.1 Fonts & texts 2.2 Colors& Combination 2.3 The taskbar: Effects, Filters, Crop, Rotate, position and transparency 2.4 Zooming, pages and notes 2.5 Animation for text and images 2.6 Background removal 2.7 Downloading, copying and sharing 2.8 Business cards 2.9 Instagram post 2.10 Instagram reel video 2.11 Creating Youtube Thumbnail Unit 3: Canva for Presentation 3.1 Overview of Canva presentation 3.2 Using Canva Default templates 3.3 Ways to present Canva presentation 3.4 Record your presentations with audio and image in Canva Unit 4: Canva Design for Enterprise and Business 4.1 Personalised flyer for event 4.2 Infographics 4.3 Resume 4.4 Websites
Reference Books	1. Design with Canva: A step by step guide on how to use Canva by LateefahRaji –Independently published 2. Design Better and Build Your Brand in Canva: A beginner's guide to producing professional branding, marketing, and social content for businesses by Laura Goodsell – Packt 3. The A to Z Field Guide to Canva: A User's Companion to Canva Terms and Features by Amanda Fox – TeacherGoals 4. Canva Tips and Tricks Beyond The Limits by Koushik K - Draft2Digital 5. Ready, Set, Brand!: The Canva for Work Quickstart Guide by Lisa Larson-Kelley - Beginners Brain 6. Graphic Design School: The Principles and Practice of Graphic Design by David Dabner, Sandra Stewart, Eric Zempel - Wiley 7. Graphic Design Theory by Helen Armstrong - Princeton Architectural Press
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level
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- 1.1.1.2 Temperature sensor
- 1.1.1.3 Motion sensor (PIR)
- 1.1.2 Reading sensor values
 - 1.1.2.1 Analog input basics
 - 1.1.2.2 Digital input basics
 - 1.1.2.3 Continuous data reading
- 1.1.3 Understanding sensor output
 - 1.1.3.1 Raw values
 - 1.1.3.2 Range of values
 - 1.1.3.3 Simple interpretation
- 1.2 Serial Communication Basics
 - 1.2.1 Introduction to serial communication
 - 1.2.1.1 What is communication?
 - 1.2.1.2 Data transfer concept
 - 1.2.2 Serial Monitor usage
 - 1.2.2.1 Displaying data
 - 1.2.2.2 Reading output
 - 1.2.2.3 Debugging using Serial Monitor
 - 1.2.3 Data formatting
 - 1.2.3.1 Text display
 - 1.2.3.2 Numeric display
 - 1.2.3.3 Structured output

Unit-2:

- 2.1 Introduction to IoT Communication
 - 2.1.1 Concept of data transmission
 - 2.1.2 Wired vs Wireless communication
- 2.2 Introduction to Wi-Fi Module
 - 2.2.1 Basic idea of Wi-Fi module
 - 2.2.2 Sending simple data
- 2.3 IoT Platforms
 - 2.3.1 Introduction to ThingSpeak
 - 2.3.2 Creating account and channel
 - 2.3.3 Sending data to cloud

Unit-3: Data Visualization and Simple Dashboard

- 3.1 Data Visualization Basics
 - 3.1.1 Why visualization is needed
 - 3.1.2 Graphs and charts
- 3.2 Viewing IoT Data
 - 3.2.1 Real-time data display
 - 3.2.2 Graph plotting
- 3.3 Basic Dashboard
 - 3.3.1 Creating simple dashboards
 - 3.3.2 Monitoring sensor data

Unit-4: Smart IoT Systems (Applied)

- 4.1 Data-Based Decision Systems
 - 4.1.1 Threshold-based decision
 - 4.1.2 If-Else logic in IoT
- 4.2 Smart Monitoring Systems
 - 4.2.1 Environment monitoring system
 - 4.2.2 Light/temperature monitoring
- 4.3 Mini Projects

	4.3.1 Data logging system 4.3.2 Smart alert system 4.3.3 Student-defined project [Students are expected to work on following suggested Practicals during Lab- hours : 1. Continuous sensor data reading ,2. Serial monitor data formatting, 3.Sending sensor data via communication module , 4. Upload data to cloud platform, 5. Create graph of sensor data, 6. Build simple dashboard, 7. Threshold-based alert system, 8. Multi-sensor data monitoring , 9. Real-time data visualization, 10. Mini IoT project] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos., (x) PIR sensor – 2 nos. (xi) Buzzer – 2 nos., (xii) Wi-Fi Module (basic) (xiii) Jumper wires (xiv) USB cable]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal

SEMESTER – 4

Course Title: Introduction to Machine Learning

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	4								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	406-01								
Course Level	200-299								
Course Title	Introduction to Machine Learning								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	1. Explain the basic concepts and evolution of Machine Learning. 2. Classify Machine Learning approaches such as supervised, unsupervised, and reinforcement learning. 3. Apply appropriate Machine Learning techniques to different problem domains. 4. Describe the complete Machine Learning workflow from data collection to model evaluation. 5. Compare various ML techniques based on performance, complexity, and applicability.								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Machine Learning 1.1 History and Evolution of Machine Learning 1.1.1 Early developments and milestones 1.1.2 Evolution from Artificial Intelligence to Machine Learning 1.2 Importance of Machine Learning 1.2.1 Role in modern technology 1.2.2 Impact on industries (healthcare, finance, retail, etc.) 1.3 Why Machine Learning is Required 1.3.1 Limitations of traditional programming 1.3.2 Need for automation and intelligent systems 1.4 Basic Concepts 1.4.1 Data, features, labels 1.4.2 Training and testing datasets								

Unit 2: Types of Machine Learning and Use Cases

2.1 Types of Machine Learning

- 2.1.1 Supervised Learning
- 2.1.2 Unsupervised Learning
- 2.1.3 Semi-Supervised Learning
- 2.1.4 Reinforcement Learning

2.2 Common Algorithms (Overview)

- 2.2.1 Regression (Linear Regression)
- 2.2.2 Classification (Decision Trees, KNN)
- 2.2.3 Clustering (K-Means)

2.3 Use Cases of Machine Learning

- 2.3.1 Recommendation systems
- 2.3.2 Fraud detection
- 2.3.3 Image and speech recognition
- 2.3.4 Predictive analytics

2.4 Application of Machine Learning

- 2.4.1 Business applications
- 2.4.2 Healthcare systems
- 2.4.3 Smart systems and automation

Unit 3: Machine Learning Process (Lifecycle)

3.1 Steps in Machine Learning Process

- 3.1.1 Data collection
- 3.1.2 Data preprocessing
- 3.1.3 Feature selection and engineering
- 3.1.4 Model selection
- 3.1.5 Training and testing
- 3.1.6 Evaluation and validation

3.2 Model Evaluation Techniques

- 3.2.1 Accuracy, precision, recall
- 3.2.2 Confusion matrix
- 3.2.3 Overfitting and underfitting

3.3 Tools and Platforms (Overview)

- 3.3.1 Python libraries (Scikit-learn, Pandas, NumPy)
- 3.3.2 ML development environments

Unit 4: Advantages, Disadvantages, and Characteristics of ML Techniques

4.1 Advantages of Machine Learning

4.2 Disadvantages of Machine Learning

4.3 Characteristics of ML Techniques

- 4.3.1 Supervised Learning: labeled data, predictive models
- 4.3.2 Unsupervised Learning: pattern discovery
- 4.3.3 Reinforcement Learning: reward-based learning

4.4 Comparison of Techniques

- 4.4.1 Strengths and weaknesses
- 4.4.2 Suitable scenarios for each method

Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	978-0262018029
	2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	978-0387310732
	3	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurélien Géron	O'Reilly Media	978-1492032649
	4	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media	978-1449369415
	5	Machine Learning	Tom M. Mitchell	McGraw-Hill	978-0070428072
	6	Python Machine Learning	Sebastian Raschka, Vahid Mirjalili	Packt Publishing	978-1789955750
	7	Understanding Machine Learning: From Theory to Algorithms	Shai Shalev-Shwartz, Shai Ben-David	Cambridge University Press	978-1107057135
	8	Applied Machine Learning	M. Gopal	McGraw-Hill Education	978-0070703698
	9	Machine Learning for Absolute Beginners	Oliver Theobald	Scatterplot Press	978-1530839407
	10	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	978-0262035613
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments				
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level				

Course Code: 406 - 02
Course Title: Data Analysis and Dashboard Reporting using Worksheet

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	4								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	406-02								
Course Level	200 - 299								
Course Title	Data Analysis and Dashboard Reporting using Worksheet								
Credit	2 (2 Theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	CO1 : Manage and clean data efficiently CO2 : Apply formulas and functions CO3 : Create reports using Power BI CO4 : Design dashboards CO5 : Present data insights								
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Power BI 1.1 Power BI environment 1.2 Data entry and formatting 1.3 Data cleaning 1.4 Sorting and filtering 1.5 Uploading CSV 1.6 Creating reports Unit 2: Visualization Techniques 2.1 Create and format visuals 2.2 Charts and graphs 2.3 Map and gauge visuals 2.4 Slicers and filters Unit 3: Reports and Dashboard 3.1 Create and modify reports 3.2 Dashboard creation 3.3 Power BI Q&A 3.4 Sharing and publishing Unit 4: DAX Functions 4.1 Date and time 4.2 Filter functions 4.3 Logical functions 4.4 Math & Trig 4.5 Text functions								

Reference Books	1) Microsoft Power BI Data Analyst Guide, Author: Daniil Maslyuk, Publisher: Packt Publishing, ISBN: 9781803232057 2) Beginning Microsoft Power BI: A Practical Guide to Self-Service Data Analytics, Author: Dan Clark, Publisher: Apress, ISBN: 9781484236238 3) Microsoft Power BI Cookbook, Author: Brett Powell, Publisher: Packt Publishing, ISBN: 9781788290141 4) Pro Power BI Desktop, Author: Adam Aspin, Publisher: Apress, ISBN: 9781484234760 5) Mastering Microsoft Power BI, Author: Brett Powell, Publisher: Packt Publishing, ISBN: 9781801811483 6) Analyzing Data with Power BI and Power Pivot for Excel, Author: Alberto Ferrari, Marco Russo, Publisher: Microsoft Press, ISBN: 9781509302764 7) Data Visualization: A Practical Introduction, Author: Kieran Healy, Publisher: Princeton University Press, ISBN : 9780691181621 8) Fundamentals of Business Intelligence, Author: Wilfried Grossmann, Stefanie Rinderle-Ma, Publisher: Springer, ISBN: 9783662574836 9) Dashboarding and Reporting with Power BI, Author: Kasper de Jonge, Publisher: Microsoft, ISBN: 9781509308025 The Definitive Guide to DAX, Author: Marco Russo, Alberto Ferrari, Publisher: Microsoft Press, ISBN: 9781509306977
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

Course Code: 406 - 03**Course Title: Data Science with Python**

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)									
Semester	4 / B.Sc. (Data Science)									
NCrF Credit level	5									
Course Type	SEC									
Course Subtype	Skill Enhancement Course (SEC)									
Subject Type	Intra-Discipline									
Course Code	406-03									
Level of Course	200-299 (Foundation/Introductory)									
Course Title	Data Science with Python									
Credits	2 Credits (30 hours of Practical/Applied knowledge)									
Implementation Year	2026-27									
Purpose of the Course	The primary purpose of this course is to provide students with a strong foundational understanding of Data Science using Python, enabling them to handle real-world data and extract meaningful insights. It aims to: • Build conceptual clarity in Data Science and its applications across industries. • Develop programming skills in Python, specifically tailored for data analysis tasks. • Equip students with data handling abilities using libraries like Pandas, including cleaning, transforming, and managing datasets. • Enhance analytical thinking by teaching how to explore and interpret data effectively. • Enable data visualization skills using tools like Matplotlib, Seaborn, and Plotly to communicate insights clearly. • Introduce core Machine Learning concepts, including supervised and unsupervised learning, and fundamental techniques like classification, regression, and clustering.									
Course Objective	(1) Provide Practical knowledge and practice of Python (2) Provide fundamental knowledge about Data Science									
Pre-requisite	Basic knowledge of Python									
Course Outcome	After successful completion of the course a student will be CO1: Able to understand about need of data science CO2: Able to work on data with visualization CO3: Able to understand how python is important in data science CO4: Able to understand about machine learning and libraries used to work in it.									
Mapping Between COs and PSOs	COs / PSOs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	

	CO1 CO2 CO3 CO4
Course content	Unit 1: Overview 1.1 Introduction to Data Science 1.2 Introduction to Python programming 1.3 Setting up Python environment (Google Colab) Unit 2: Data Manipulation with Pandas 2.1 Introduction to Pandas Library 2.2 Data Cleaning and manipulation with Pandas 2.3 Handling missing data 2.4 Grouping, aggregating, merging and joining data frames Unit 3: Data Visualization with Matplotlib and Seaborn 3.1 Introduction to data visualization 3.2 Plotting and customization with Matplotlib 3.3 Seaborn for statistical visualization 3.4 Creating interactive visualization with Plotly Unit 4: Fundamentals of Machine learning 4.1 Introduction to machine learning 4.2 Supervised and unsupervised learning 4.3 Classification, Regression and Clustering
Reference Books	- Sharma, R.K., Nandi. G (2020). Data Science fundamentals and practical approaches: Understand why data science is the Next, India: BPB Publications. ISBN: 9789389845662, 9389845661 - Mulla, R. (2019) Data Science with Python: For complete Beginners - VanderPlas, J., Python Data Science Handbook, O'Reilly - Foundations of Data Science with Python, John M. Shea, CRC Press, 9781032350424, 2024 - From Concepts to Code: Introduction to Data Science, Adam P. Tashman, CRC Press, 9781032517957, 2024 - Software Engineering for Data Scientists, Catherine Nelson, O'Reilly Media, 9781098136208, 2024 - Linear Algebra in Data Science, Peter Zizler & Roberta La Haye, Springer, 9783031549076, 2024 - Graph Algorithms for Data Science, Tomaž Brataniz, Manning Publications, 9781617299469, 2024 - Data Science for Decision Makers, Erik Herman, Independently Published, 9781501520648, 2024 - AI Snake Oil: What Artificial Intelligence Can Do, What It Can't, and How to Tell the Difference, Arvind Narayanan & Sayash Kapoor, Princeton University Press, 9780691249131, 2024
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level
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	1.1.2.1 Rule-based systems 1.1.2.2 Intelligent systems 1.2 Introduction to Machine Learning 1.2.1 What is Machine Learning? 1.2.1.1 Learning from data 1.2.1.2 Examples 1.2.2 Types of learning 1.2.2.1 Supervised learning 1.2.2.2 Unsupervised learning 1.3 IoT Data for AI 1.3.1 Source of IoT data 1.3.2 Data collection from sensors 1.3.3 Preparing data for analysis Unit-2: Basic Data Analysis using Python 2.1 Introduction to Python for Data 2.1.1 Basic Python concepts 2.1.2 Reading data 2.2 Data Handling 2.2.1 Introduction to Pandas 2.2.1.1 DataFrame concept 2.2.1.2 Reading CSV data 2.2.2 Data cleaning 2.2.2.1 Missing values 2.2.2.2 Formatting data 2.3 Data Visualization 2.3.1 Introduction to Matplotlib 2.3.2 Plotting simple graphs 2.3.3 Understanding trends Unit-3: Simple Machine Learning Models 3.1 Introduction to ML Tools 3.1.1 Introduction to Scikit-learn 3.1.2 Basic workflow 3.2 Classification 3.2.1 Concept of classification 3.2.2 Example: Temperature → Normal / High 3.2.3 Using simple classification models 3.2.4 Simple Prediction-based Model 3.2.5 Using data to predict output Unit-4: Unit-4: AI-Based IoT Applications (Projects) 4.1 Smart Decision Systems 4.1.1 Sensor data → decision 4.1.2 Intelligent alert systems 4.2 AI-Based Mini Applications 4.2.1 Smart temperature monitoring 4.2.2 Smart light control system 4.2.3 Basic anomaly detection 4.3 Mini Projects 4.3.1 Data collection + analysis 4.3.2 Model application
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	4.3.3 Output decision system [Students are expected to work on following suggested Practicals during Lab- hours : 1. Collect IoT data and save as CSV, 2. Load data using Python, 3. Clean and preprocess data , 4. Plot sensor data graph, 5. Simple classification example, 6. Apply KNN model (basic), 7. Threshold-based prediction, 8. Build simple decision system, 9. Combine IoT + ML, 10. Final mini project] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos., (x) PIR sensor – 2 nos. (xi) Buzzer – 2 nos., (xii) Wi-Fi Module (basic) (xiii) Jumper wires (xiv) USB cable]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal

SEMESTER – 5

Course Title: Working with AI Based Software

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)									
Semester	5									
NCrF Credit Level	5.5									
Course Type	SEC									
Course Subtype	Skill Development									
Subject Type	Discipline Specific, Emerging Technology									
Course Code	506-01									
Course Level	200 - 299									
Course Title	Working with AI based Software									
Credit	2 (2 Theory)									
Effective From	A.Y. 2026 - 27									
Course Outcomes	CO1 : Understand the core concepts and architecture of AI. CO2 : Identify and apply free AI tools for academic, research, and creative tasks. CO3 : Use AI tools to automate writing, video creation, and presentation design. CO4 : Create engaging academic content with minimal effort using AI platforms. CO5 : Make informed and ethical decisions while using AI in their academic journey.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Artificial Intelligence (7.5 Hours) 1.1. Definition and history of AI 1.2. Types of AI: Narrow, General, and Super AI 1.3. Applications of AI in education, healthcare, and daily life 1.4. Ethical concerns and responsible AI usage 1.5. AI vs Human intelligence: Myths and facts Unit 2: Architecture of AI Systems (7.5 Hours) 2.1 AI System components: Input, Processing, Output 2.2 Basic structure of AI algorithms and models 2.3 Role of data, training, and feedback loops in AI 2.4 Concept of Machine Learning, Deep Learning, and Natural Language Processing 2.5 AI workflow: From problem to solution Unit 3: Free AI Tools for Academic Tasks (7.5 Hours) 3.1 List and demo of AI tools for: 3.1.1 Writing & summarizing (e.g., Grammarly, Quillbot, ChatGPT) 3.1.2 Presentation generation (e.g., Beautiful.ai, Tome.app)									

	3.1.3 Research assistance (e.g., Elicit.org, Semantic Scholar, Research Rabbit) 3.2 Benefits and limitations of each tool 3.3 AI tools for document formatting and language translation Unit 4: AI for Multimedia, Video Creation & Study Support (7.5 Hours) 4.1 AI tools for video making (e.g., Pictory, Lumen5, Animoto) 4.2 Text-to-speech and voiceover tools (e.g., ElevenLabs, Natural Readers) 4.3 Image generation tools (e.g., Canva AI, Craiyon, Bing Image Creator) 4.4 AI chatbots as study companions (e.g., Socratic, ChatGPT, You.com) 4.5 Mini-project: Create a study video or presentation using AI tools 4.6 Mini-project: Create website or python project using AI tool.
Reference Books	1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson Education, ISBN-13: 978-0134610993 2. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, ISBN-13: 978-1484235155 3. Machine Learning for Absolute Beginners, Oliver Theobald, CreateSpace, ISBN - 978-1520951400 4. ChatGPT for Beginners, Pam Baker, Wiley, ISBN - 978-1394203783 5. Ethics of Artificial Intelligence, Mark Coeckelbergh, MIT Press, ISBN - 978-0262538190 6. "Artificial Intelligence: A Guide for Thinking Humans", Melanie Mitchell, Farrar, Straus and Giroux (US), ISBN-978-1250758040 7. "AI Basics for anyone", Dale Lane, ISBN - 978-1718500563 8. "Hands-On Artificial Intelligence for Beginners", Patrick D. Smith, Packt Publishing Ltd, ISBN - 978-1788991063 9. Generative AI Basics & Beyond, Tom Taulli, Apress, 9781484293538 10. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, 9781484233572
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

[Subject code-2511000905060180]

Course Code: 506-02

Course Title: Fundamentals of Software Engineering

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)
Semester	5
NCrF Credit level	5
Course Type	SEC
Course Subtype	Skill Enhancement Course (SEC)
Subject Type	Intra-Discipline
Course Code	506-02
Level of Course	200-299
Course Title	Fundamental of Software Engineering
Credits	2 Credits (30 hours of Practical/Applied knowledge)
Implementation Year	2026-27
Purpose of Course	The purpose of this course is to provide students with a comprehensive understanding of Software Engineering principles and practices, enabling them to systematically develop high-quality software systems. It aims to: • Introduce fundamental concepts of software and software engineering, including types of software and their characteristics. • Develop knowledge of software development life cycle (SDLC) and various process models such as Waterfall, Prototype, Incremental, and Spiral. • Build analytical skills to study existing systems, identify limitations, and prepare structured Software Requirement Specifications (SRS). • Equip students with modeling techniques like DFD and UML diagrams (Use Case, Activity, Sequence) for clear system representation. • Enhance design capabilities by understanding key principles, concepts, cohesion, and coupling for creating efficient system architectures. • Provide knowledge of software testing practices, including test case design, types of testing, and handling security and system limitations. • Enable practical application of concepts through real-world case studies like College Management Systems and other domain-based systems.
Course Objective	(1) Provide knowledge and practice of Software Engineering phases like analysis, design and testing (2) Provide fundamental knowledge about Software Requirement Specification and Software Process Model
Pre-requisite	Basic understanding of Problem Solving
Course Outcome	After successful completion of this course, students will be able to: CO1: Understand and explain fundamental concepts of software, software engineering, and various software process models.

	CO2: Analyze existing systems, identify their limitations, and prepare a structured Software Requirement Specification (SRS). CO3: Apply modeling techniques such as DFD and UML diagrams (Use Case, Activity, Sequence) to represent system requirements effectively. CO4: Design software systems using appropriate design principles, concepts, and by applying cohesion and coupling. CO5: Develop and evaluate test cases, understand different testing techniques, and identify security issues and system limitations. CO6: Apply software engineering concepts to real-world case studies like College Management System and other domain-based applications.																																																															
Mapping Between COs and PSOs	<table><tr><th>COs</th><th>PSO 1</th><th>PSO 2</th><th>PSO 3</th><th>PSO 4</th><th>PSO 5</th><th>PSO 6</th><th>PSO 7</th><th>PSO 8</th></tr><tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	CO1									CO2									CO3									CO4									CO5									CO6								
COs	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8																																																								
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CO3																																																																
CO4																																																																
CO5																																																																
CO6																																																																
Course content	Unit 1: Software and Software Engineering 1.1 Concepts of Software 1.2 Software characteristics 1.3 Types of Software 1.4 Overview of Software Engineering 1.5 Software Process Model 1.5.1 Waterfall Model 1.5.2 Prototype Model 1.5.3 Incremental Model 1.5.4 Spiral Model Unit 2: Analysis Report 2.1 Fact Finding: Current System and its limitations 2.2 Introduction to SRS and its characteristics 2.3 Proposed System and its advantages 2.4 Elements of Analysis Model 2.5 DFD, PSPEC, DD 2.6 Unified Modeling Language (UML) 2.6.1 UML Diagrams 2.6.1.1 Use Case Diagram 2.6.1.2 Activity Diagram 2.6.1.3 Sequence Diagram Unit 3: Design Report and Testing Report 3.1 Design Principles 3.2 Design Concepts 3.3 Overview: Cohesion and Coupling 3.4 Overview: Testing and its types 3.5 Test Case Design 3.6 Testing issues 3.7 Security Issue 3.8 Limitations of proposed system 3.7 Future Enhancement																																																															

	Unit 4: Case Study 4.1 College Management System 4.2 Self study: Online Shopping System 4.3 Self study: Tours and Travels Management System
Reference Books	11. Software Engineering , A Practitioners Approach , Roger Pressman 2018, Mc Graw Hill Education, ISBN: 978-9353165710 12. Software Engineering with UML, Bhuvan Unhelkar, 2017, CRC Press ISBN : 978-1138297432 13. Grady Booch, James Rumbaugh, Ivar Jacobson Unified Modeling Language User Guide Addison Wesley 14. Engineering Software Products (Global Edition eText), Ian Sommerville, Pearson, 9781292474601, 2024 15. Software Engineering (10th Edition – updated digital/global), Ian Sommerville, Pearson, 9781292443157, 2023 16. Software Engineering (Global Edition eText), Ian Sommerville, Pearson, 9781292770680, 2026 (latest update, based on 2023 edition) 17. Software Engineering at Google: Lessons Learned from Programming Over Time, Titus Winters, Tom Manshreck & Hyrum Wright, O'Reilly Media, 9781492082798, 2020 18. Modern Software Engineering: Doing What Works to Build Better Software Faster, David Farley, Addison-Wesley, 9780137314911, 2021 19. Software Engineering for Data Scientists, Catherine Nelson, O'Reilly Media, 9781098136208, 2024
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests (Theory /Practical /MCQ) at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level

	1.1.3.2 Actuators 1.1.3.3 Controller 1.2 Basic Electronic Components 1.2.1 LED (Light Emitting Diode) 1.2.1.1 Structure and polarity 1.2.1.2 Applications 1.2.2 Resistor 1.2.2.1 Purpose of resistor 1.2.2.2 Basic idea of resistance 1.2.3 Jumper wires and connectors 1.2.4 Power supply (Battery / USB) 1.3 Breadboard and Circuit Basics 1.3.1 Introduction to breadboard 1.3.2 Internal connections of breadboard 1.3.3 Basic circuit building concepts 1.4 Introduction to Arduino 1.4.1 What is Arduino? 1.4.2 Purpose and importance 1.4.3 Overview of Arduino board components Unit 2 : Understanding Arduino and Basic Programming 2.1 Arduino Fundamentals 2.1.1 Introduction to Arduino (with reference to Arduino Uno) 2.1.2 Role of Arduino as controller 2.1.3 Basic architecture (simple explanation) 2.2 Arduino Pins and Connections 2.2.1 Digital pins 2.2.2 Power pins (5V, GND) 2.2.3 Input and Output concept 2.3 Arduino Software Setup 2.3.1 Installation of Arduino IDE 2.3.2 Connecting Arduino to computer 2.3.3 Uploading first program 2.4 Basic Programming Structure 2.4.1 Structure of Arduino program 2.4.1.1 setup() function 2.4.1.2 loop() function 2.4.2 Basic commands (digitalWrite, delay) 2.4.3 Understanding program flow Unit-3 : Interfacing Input and Output Devices 3.1 Output Devices 3.1.1 LED as output device 3.1.2 Controlling LED using Arduino 3.2 Input Devices 3.2.1 Push button 3.2.2 Working principle of switch 3.2.3 Reading input from button 3.3 Input–Process–Output Concept 3.3.1 Basic system model 3.3.2 Real-life examples 3.4 Practical Interfacing 3.4.1 LED blinking program
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	3.4.2 Button-controlled LED 3.4.3 Changing delay and behavior Unit-4: Introduction to Sensors and Basic IoT Applications 4.1 Introduction to Sensors 4.1.1 What is a sensor? 4.1.2 Types of sensors (basic overview) 4.2 Common Sensors 4.2.1 Light sensor (LDR) 4.2.1.1 Working principle 4.2.1.2 Applications 4.2.2 Temperature sensor 4.2.2.1 Basic concept 4.2.2.2 Applications 4.3 Sensor Data Handling 4.3.1 Reading sensor values 4.3.2 Serial Monitor usage 4.3.3 Displaying output 4.4 Basic IoT Applications 4.4.1 Concept of smart devices 4.4.2 Simple automation idea 4.4.3 Introduction to real-world applications 4.4.3.1 Smart lighting 4.4.3.2 Temperature monitoring [Students are expected to work on following suggested Practicals during Lab- hours : 1. Identification of electronic components, 2. LED circuit using battery, 3. Breadboard circuit setup, 4. Arduino LED blinking program, 5. Changing LED blinking speed, 6. Button-controlled LED, 7. Multiple LED blinking, 8. LDR sensor reading, 9. Temperature sensor reading, 10. Display output on Serial Monitor] [Suggested components for lab : (One set per 10 students): (i) Arduino Uno – 1, (ii) Breadboard – 1, (iii) USB Cable – 1 (iv) LEDs –10nos. (v) Resistors – Assorted (vi) Jumper wires – Set (vii) Push buttons –3nos. (viii) LDR sensor – 1nos. (ix) Temperature sensor – 1nos.]
Reference Books	1. Getting Started with Arduino (3rd Edition), 978-9352139819, Massimo Banzi, Maker Media 2. Arduino Cookbook, 978-1449313876, Michael Margolis, O'Reilly Media 3. Programming Arduino: Getting Started with Sketches, 978-0071784229, Simon Monk, McGraw-Hill Education 4. Exploring Arduino: Tools and Techniques for Engineering Wizardry, 978-1119405373, Jeremy Blum, Wiley 5. Internet of Things: A Hands-On Approach, 978-0996025515, Arshdeep Bahga and Vijay Madisetti, Universities Press 6. Learning Internet of Things, 978-1788399119, Peter Waher, Packt Publishing 7. Beginning Arduino, 978-1430232401, Michael McRoberts, Apress 8. Make: Electronics (2nd Edition), 978-1680450260, Charles Platt, Maker Media 9. Practical Electronics for Inventors (4th Edition), 978-1259587549, Paul Scherz and Simon Monk, McGraw-Hill Education 10. Hands-On Internet of Things with MQTT, 978-1789341780, Agus Kurniawan, Packt Publishing
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments

Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Practical Unit tests. - Practical exam, viva-voce, E-Journal 50% External assessment. - Practical Exam, viva-voce, E-Journal
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Course Code: 306-01
Course Title: EDA using Python

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)								
Semester	3								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	306-01								
Course Level	200-299								
Course Title	EDA using Python								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	6. Understand different types of data and sources 7. Identify and handle data errors effectively 8. Use Python libraries for data cleaning and analysis 9. Create meaningful visualizations 10. Perform complete EDA on real-world datasets								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Data and Data Sources 1.2 Types of Data 1.2.1 Structured, Semi-structured, and Unstructured Data 1.2.2 Qualitative vs Quantitative Data 1.2.3 Discrete vs Continuous Data 1.2.4 Time-series and Cross-sectional Data 1.3 Data Sources 1.4 .1 Primary vs Secondary Data 1.2.2 Open data sources (government portals, APIs) 1.2.3 Web scraping basics 1.3 Types of Databases 1.3.1 Relational Databases (RDBMS)								

1.3.2 NoSQL Databases (MongoDB, Cassandra)
1.3.3 Data Warehouses and Data Lakes
1.5 Types of Data Files
1.4.2 CSV, Excel, JSON, XML, TXT
1.4.2. Differences and use cases
1.5.3 File handling basics in Python
1.6 Introduction to Python for EDA
1.5.2 Python environment setup (Anaconda/Jupyter Notebook)
1.5.2 Basic syntax and data structures (lists, dictionaries, tuples)
Unit 2: Data Quality, Errors, and Cleaning
2.3 Common Errors in Data
2.3.1 Missing values (NaN, NULL)
2.3.2 Duplicate data
2.3.3 Inconsistent formats (date, text, units)
2.3.4 Outliers and noise
2.1.5 Typographical errors
2.4 Disadvantages of Poor Data Quality
2.5 Importance of Data Cleaning
2.6 Data Cleaning Techniques
2.6.1 Handling missing values (imputation, deletion)
2.6.2 Removing duplicates
2.6.3 Data type conversion
2.6.4 String cleaning and formatting
2.6.5 Outlier detection and treatment
Unit 3: Python Libraries for Data Cleaning and Analysis
3.5 Introduction to Key Libraries
3.1. 1NumPy (numerical operations)
3.1.2 Pandas (data manipulation)
3.6 Pandas Functions for Data Cleaning
3.6.1 read_csv(), read_excel()
3.6.2 info(), describe()
3.6.3 isnull(), dropna(), fillna()
3.6.4 duplicated(), drop_duplicates()
3.6.5 astype()
3.2.6 apply(), map()
3.7 Data Transformation
3.7.1 Filtering and sorting data
3.7.2 Grouping (groupby())
3.7.3 Merging and joining datasets
3.3.4 Feature creation and modification
3.8 Introduction to Data Analysis
3.8.1 Descriptive statistics
3.8.2 Correlation and covariance
3.4.3 Aggregation techniques
Unit 4: Data Visualization Techniques in Python
4.1 Importance of Data Visualization
4.4 Visualization Libraries
4.4.1 Matplotlib
4.4.2 Seaborn
4.2.3 Plotly (basic introduction)
4.5 Types of Visualizations
4.5.1 Line charts
4.5.2 Bar charts

	4.5.3 Histograms 4.5.4 Scatter plots 4.5.5 Box plots 4.3.5 Heatmaps				
Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	Python for Data Analysis	Wes McKinney	O'Reilly Media	978-1491957660
	2	Data Science from Scratch	Joel Grus	O'Reilly Media	978-1492041139
	3	Practical Statistics for Data Scientists	Peter Bruce, Andrew Bruce	O'Reilly Media	978-1492072942
	4	Hands-On Data Analysis with Pandas	Stefanie Molin	Packt Publishing	978-1789615326
	5	Data Wrangling with Python	Jacqueline Kazil, Katharine Jarmul	O'Reilly Media	978-1491948811
	6	Python Data Science Handbook	Jake VanderPlas	O'Reilly Media	978-1491912058
	7	Think Stats	Allen B. Downey	O'Reilly Media	978-1491907337
	8	Introduction to Data Science	Laura Igual, Santi Seguí	Springer	978-3319500164
	9	Applied Data Science with Python	Alex Galea	Packt Publishing	978-1786468253
	10	Mastering Pandas	Femi Anthony	Packt Publishing	978-1789343236
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments				
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level				

[Subject code-2611000904060268]

Course Code: 406-1

Course Title: Introduction to Machine Learning

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science)/ B.Sc. (Data Science)								
Semester	4								
NCrF Credit Level	5								
Course Type	SEC								
Course Subtype	Skill Development								
Subject Type	Discipline Specific								
Course Code	406-01								
Course Level	200-299								
Course Title	Introduction to Machine Learning								
Credit	2 (2 theory)								
Effective From	A.Y. 2026 - 27								
Course Outcomes	1. Explain the basic concepts and evolution of Machine Learning. 2. Classify Machine Learning approaches such as supervised, unsupervised, and reinforcement learning. 3. Apply appropriate Machine Learning techniques to different problem domains. 4. Describe the complete Machine Learning workflow from data collection to model evaluation. 5. Compare various ML techniques based on performance, complexity, and applicability.								
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
	CO1								
	CO2								
	CO3								
	CO4								
	CO5								
Course Content	Unit 1: Introduction to Machine Learning 1.1 History and Evolution of Machine Learning 1.1.1 Early developments and milestones 1.1.2 Evolution from Artificial Intelligence to Machine Learning 1.2 Importance of Machine Learning 1.2.1 Role in modern technology 1.2.2 Impact on industries (healthcare, finance, retail, etc.) 1.3 Why Machine Learning is Required 1.3.1 Limitations of traditional programming 1.3.2 Need for automation and intelligent systems 1.4 Basic Concepts 1.4.1 Data, features, labels 1.4.2 Training and testing datasets Unit 2: Types of Machine Learning and Use Cases 2.1 Types of Machine Learning 2.1.1 Supervised Learning 2.1.2 Unsupervised Learning								

	2.1.3 Semi-Supervised Learning 2.1.4 Reinforcement Learning 2.2 Common Algorithms (Overview) 2.2.1 Regression (Linear Regression) 2.2.2 Classification (Decision Trees, KNN) 2.2.3 Clustering (K-Means) 2.3 Use Cases of Machine Learning 2.3.1 Recommendation systems 2.3.2 Fraud detection 2.3.3 Image and speech recognition 2.3.4 Predictive analytics 2.4 Application of Machine Learning 2.4.1 Business applications 2.4.2 Healthcare systems 2.4.3 Smart systems and automation Unit 3: Machine Learning Process (Lifecycle) 3.1 Steps in Machine Learning Process 3.1.1 Data collection 3.1.2 Data preprocessing 3.1.3 Feature selection and engineering 3.1.4 Model selection 3.1.5 Training and testing 3.1.6 Evaluation and validation 3.2 Model Evaluation Techniques 3.2.1 Accuracy, precision, recall 3.2.2 Confusion matrix 3.2.3 Overfitting and underfitting 3.3 Tools and Platforms (Overview) 3.3.1 Python libraries (Scikit-learn, Pandas, NumPy) 3.3.2 ML development environments Unit 4: Advantages, Disadvantages, and Characteristics of ML Techniques 4.1 Advantages of Machine Learning 4.2 Disadvantages of Machine Learning 4.3 Characteristics of ML Techniques 4.3.1 Supervised Learning: labeled data, predictive models 4.3.2 Unsupervised Learning: pattern discovery 4.3.3 Reinforcement Learning: reward-based learning 4.4 Comparison of Techniques 4.4.1 Strengths and weaknesses 4.4.2 Suitable scenarios for each method				
Reference Books	Sr. No.	Book Name	Author(s)	Publication	ISBN
	1	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy	MIT Press	978-0262018029

	2	Pattern Recognition and Machine Learning	Christopher M. Bishop	Springer	978-0387310732
	3	Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow	Aurélien Geron	O'Reilly Media	978-1492032649
	4	Introduction to Machine Learning with Python	Andreas C. Müller, Sarah Guido	O'Reilly Media	978-1449369415
	5	Machine Learning	Tom M. Mitchell	McGraw-Hill	978-0070428072
	6	Python Machine Learning	Sebastian Raschka, Vahid Mirjalili	Packt Publishing	978-1789955750
	7	Understanding Machine Learning: From Theory to Algorithms	Shai Shalev-Shwartz, Shai Ben-David	Cambridge University Press	978-1107057135
	8	Applied Machine Learning	M. Gopal	McGraw-Hill Education	978-0070703698
	9	Machine Learning for Absolute Beginners	Oliver Theobald	Scatterplot Press	978-1530839407
	10	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	978-0262035613
Teaching Methodology		Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments			
Evaluation Method		50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level			

[Subject code-2511000905060186]

Course Code: 506-01

Course Title: Working with AI Based Software

Program Name	BCA / B.Voc.(I.T.) / B.Sc.(C.A.)/ B.C.A.(A.I. & Data Analytics) / B.C.A. (Cyber Security) / B.C.A. (Data Science) / B.Sc. (Data Science)									
Semester	5									
NCrF Credit Level	5.5									
Course Type	SEC									
Course Subtype	Skill Development									
Subject Type	Discipline Specific, Emerging Technology									
Course Code	506-01									
Course Level	300 - 399									
Course Title	Certificate in Working with AI based Software									
Credit	2 (2 Theory)									
Effective From	A.Y. 2026 - 27									
Course Outcomes	CO1 : Understand the core concepts and architecture of AI. CO2 : Identify and apply free AI tools for academic, research, and creative tasks. CO3 : Use AI tools to automate writing, video creation, and presentation design. CO4 : Create engaging academic content with minimal effort using AI platforms. CO5 : Make informed and ethical decisions while using AI in their academic journey.									
Mapping between Cos and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	
	CO1									
	CO2									
	CO3									
	CO4									
	CO5									
Course Content	Unit 1: Introduction to Artificial Intelligence (7.5 Hours) 1.6. Definition and history of AI 1.7. Types of AI: Narrow, General, and Super AI 1.8. Applications of AI in education, healthcare, and daily life 1.9. Ethical concerns and responsible AI usage 1.10. AI vs Human intelligence: Myths and facts Unit 2: Architecture of AI Systems (7.5 Hours) 2.6 AI System components: Input, Processing, Output 2.7 Basic structure of AI algorithms and models 2.8 Role of data, training, and feedback loops in AI 2.9 Concept of Machine Learning, Deep Learning, and Natural Language Processing 2.10 AI workflow: From problem to solution Unit 3: Free AI Tools for Academic Tasks (7.5 Hours) 3.4 List and demo of AI tools for: 3.4.1 Writing & summarizing (e.g., Grammarly, Quillbot, ChatGPT) 3.4.2 Presentation generation (e.g., Beautiful.ai, Tome.app) 3.4.3 Research assistance (e.g., Elicit.org, Semantic Scholar, Research Rabbit)									

	3.5 Benefits and limitations of each tool 3.6 AI tools for document formatting and language translation Unit 4: AI for Multimedia, Video Creation & Study Support (7.5 Hours) 4.7 AI tools for video making (e.g., Pictory, Lumen5, Animoto) 4.8 Text-to-speech and voiceover tools (e.g., ElevenLabs, Natural Readers) 4.9 Image generation tools (e.g., Canva AI, Craiyon, Bing Image Creator) 4.10 AI chatbots as study companions (e.g., Socratic, ChatGPT, You.com) 4.11 Mini-project: Create a study video or presentation using AI tools 4.12 Mini-project: Create website or python project using AI tool.
Reference Books	1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson Education, ISBN-13: 978-0134610993 2. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, ISBN-13: 978-1484235155 3. Machine Learning for Absolute Beginners, Oliver Theobald, CreateSpace, ISBN - 978-1520951400 4. ChatGPT for Beginners, Pam Baker, Wiley, ISBN - 978-1394203783 5. Ethics of Artificial Intelligence, Mark Coeckelbergh, MIT Press, ISBN - 978-0262538190 6. "Artificial Intelligence: A Guide for Thinking Humans", Melanie Mitchell, Farrar, Straus and Giroux (US), ISBN-978-1250758040 7. "AI Basics for anyone", Dale Lane, ISBN - 978-1718500563 8. "Hands-On Artificial Intelligence for Beginners", Patrick D. Smith, Packt Publishing Ltd, ISBN - 978-1788991063 9. Generative AI Basics & Beyond, Tom Taulli, Apress, 9781484293538 10. Artificial Intelligence Basics: A Non-Technical Introduction, Tom Taulli, Apress, 9781484233572
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars, Assignments, Viva-Voce/ Presentation
Evaluation Method	50% Internal assessment. - Attendance, Class and home Assignment, Unit tests at college level 50% External assessment. - Test, Presentation, Practical Exam, Viva-Voce at college Level