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-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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–: પરિપત્ર :–

કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા હેઠળની સંલગ્ન તમામ બીસીએ કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૫–૨૬ થી અમલમાં આવનાર B.C.A. (Artificial Intelligence and Data Analytics) Sem.- 3 & 4 Specialization નો પેટાસમિતિ દ્વારા તૈયાર કરવામાં આવેલ અભ્યાસક્રમ કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા તથા કોમ્પ્યુટર સાયન્સ વિષયની અભ્યાસ સમિતિની તા.૧૬/૦૬/૨૦૨૫ ની સંયુકત સભાના ઠરાવ ક્રમાંક : ૦૬ થી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૨૪/૧૨/૨૦૨૪ ની સભાનાં ઠરાવ ક્રમાંકઃ૩૫૩ અન્વયે માનનીય કુલપતિશ્રીને આપેલ સત્તા અંતર્ગત એકેડેમિક કાઉન્સિલવતી માન.કુલપતિશ્રીએ મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંકઃઓથો./પરિપત્ર/૧૫૧૮૪/૨૦૨૫
તા.૧૬–૦૬–૨૦૨૫

કુલસચિવ

પ્રતિ,

૧) યુનિવર્સિટી સંલગ્ન તમામ બીસીએ કોલેજોના આચાર્યશ્રીઓ.
.....આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકો/વિદ્યાર્થીને જાણ કરી અમલ કરવા સારૂ.

૨) ઈ.ચા.ડીનશ્રી, કોમ્પ્યુટર સાયન્સ વિદ્યાશાખા.

૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University, Surat

Computer Science and Information Technology Faculty

Syllabus for (Semester-III and Semester-IV) of

B.C.A. (Artificial Intelligence and Data Analytics)(Honours)

As per NEP-2020

To be implemented from

Academic Year: June, 2025-2026

(Including Winter Session)

Veer Narmad South Gujarat University, Surat
Bachelor of Computer Application
(B.C.A.(Artificial Intelligence and Data Analytics)(Honours))
Under the Faculty of
Computer Science and Information Technology

Name of Program:	Bachelor of Computer Application (Artificial Intelligence and Data Analytics) (Honours)
Abbreviation:	B.C.A.(A.I. & Data Analytics)(Honours): Four-year Integrated Program. With Multi-Level Entry and Exit option
Multi-level Exit Criteria:	i) Under Graduate Certificate in Computer Application: 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 Computer Application: 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.C.A. (Bachelor's in Computer Application): 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:	Four year of B.C.A.(A.I. & Data Analytics)(Honors) degree program with multi-level exit options at 1st, 2nd and 3rd Year to obtain Certificate, Diploma, Degree and Honours Degree in Computer Application respectively.
Eligibility:	As per the norms of University.
Objective of the Program:	The objective of the "B.C.A. Specialization in A.I. and Data Analytics" program is to equip students with comprehensive knowledge and practical skills in artificial intelligence and data analytics. The program aims to develop a deep understanding of AI algorithms, machine learning techniques, and statistical methods for data analysis. Students will learn to design, implement, and evaluate AI-driven solutions to real-world problems, leveraging big data technologies and advanced analytical tools. The curriculum is designed to foster critical thinking, problem-solving, and

	innovation, preparing graduates to tackle complex challenges in various industries. Emphasis is placed on hands-on experience through projects, internships, and collaborative research. By the end of the program, students will be proficient in programming languages, data management, data analysis, analytics, data visualization and AI frameworks, ready to study further and pursue careers in the field of data science, data analyst, Business intelligence, Business Analytics, Prompt engineering, AI specialists, and analytics professionals in a rapidly evolving technological landscape.
Program Outcome:	**PO1:** Ability to analyze a problem, identify and define the Computing requirements appropriate to its solution. **PO2:** Enhancing the problem solving, logical, reasoning and analysis capabilities of a problem and integrate the ability with the coding using specific computer programming languages. **PO3:** To generate Understanding regarding the core and fundamental ideas about the computer platforms, operating systems, software design concepts, networking concepts and advanced and emerging technologies. **PO4:** Design, implement and evaluate a computer-based system, processing, component or program to meet desired goal with the help of various programming languages, application software, packages, tools, databases on various platforms. **PO5:** An ability to apply design and development principles in construction of software systems of varying complexity using various algorithmic principles, modeling, coding and design of computer-based systems. **PO6:** Prepare the aspiring students to become computer software professionals who can work in corporate/software industry at entry to advanced level as well as independent developers. Overall, the program outcomes aim to produce graduates who are: (a) competent in computer application, development and design. (b) Adapt to changing technology and industry trends. (c) Can make significant contributions to the software applications coding, designing, database managements, testing, deployments and ready to adapt any upcoming technologies.
Program Specific Outcome:	**PSO1:** Developing understanding about the fundamentals of core concepts of logic developments, critical thinking and problem solving capabilities. Emphasis on effective communication. **PSO2:** Improving analytical and applied concepts using various technologies, coding concepts and implementation of coding to solve the problems. **PSO3:** Development of team building concepts and working in team with positive approach, enhancing the mindset to contribute as an individual to the team. Improving interpersonal skills. **PSO4:** Improving student's Understanding related to technical problems and enhancing their capabilities to address the problems to turn into

<table>
<tr><td></td><td>solutions through various possible ways by enhancing critical thinking ability.

PSO5: Develop students to capabilities for self-learning, skill development through self-practicing and problem solving abilities.

PSO6: Develop students to address and work on the real-world problems as an individual and as part of team. Understand the business problems and ability to work on their solutions by applying various software technologies.

PSO7: To enhance development skills at various level including problem analysis, data analysis, logical and critical analysis of the problems and implementing the solutions by imparting various recent and upcoming technologies.

PSO8: Enhance the passion among the students for updating knowledge, innovative ideas, upskilling and implementing the knowledge in applied areas and research areas by understanding the real world problems, addressing the real world problems and their possible solutions that lead to build a successful Professional career.</td></tr>
<tr><td>PO and PSO mapping:</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>PO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>PO6</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Medium of Instruction:</td><td>English</td></tr>
<tr><td>Program Structure:</td><td>Semester-wise Breakup of the course is given as follows :</td></tr>
</table>

Veer Narmad South Gujarat University, Surat

Program Structure: S.Y.B.C.A. (Artificial Intelligence and Data Analytics)

(SEM – 3 and SEM – 4)

(w.e.f. Academic Year June, 2025-2026)

Bachelor of Computer Application (B.C.A.) – Three Year Program

Bachelor of Computer Application (B.C.A.(Hon.)) – Four Year Integrated Program

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
302-02	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	3	2
303-05	Fundamentals of Machine Learning	Major Course	300-399 Higher Level Courses	4	2	4
304-05	AI-Oriented Programming and Data Structures in Python (A.I.O.P.D.)	Major Course	300-399 Higher Level Course	4	3	2
305-05	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)** [The student will undergo field training/ internship training OR Select minimum one University approved and recognized 2 credit certificate course from the skill based courses list offered by the respective institute/department.] (The student need to enrol separately and pay the fees as decided by the respective institute/department)	Skill Enhancement Course	200-299 Intermediate Level Course	2	2	-
307	**Value Addition Course – III (VAC-03)** [The student will select minimum one University approved and recognized 2 credits certificate course from the Value Addition courses list offered by the respective institute/department.] (The student need to enrol separately and pay the fees as decided by the respective institute/department)	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	16	12

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
302-02	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	25 25	25 25	100
303-05	Fundamentals of Machine Learning (Major Course)**	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
304-05	AI-Oriented Programming and Data Structures in Python (A.I.O.P.D.)** (Major Course)	4	Theory/ Written : Practical :	1 Hours 2 Hours	25 25	25 25	100
305-05	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	Value Addition Course-III# (VAC-03)	2	-	-	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-302, course-303, course-304 and course-305. **Minimum** Ten Practical hours (2 Hours for course-302, course-304 and 4 hours for course-303 and course-305) 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 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.

Internship: A student who wish to exit after successfully completion of Second year (Semester-3 and Semester-4) without any backlog is required to obtain Four credits at the end of the year either through the summer internship or university approved skill based certificate courses(two courses of 2-credits each or one 4-credit course). Student is required to enrol for the certificate courses separately by paying the course fees as decided by the college/institute. For summer training, the Institute/college will grant the permission and evaluate the training outcomes. Based on satisfactory completion of the summer training, the Institute head will recommend to the university to grant four credits for summer training. The Internship/summer training/skill based certificate courses will be an audit course.[The internship cost/fees will be bear by the student.]

Skill Enhancement 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 (From available basket of courses as per University norms). It will be mandatory for the student to opt minimum one 2-credit Skill enhancement course out of offered courses recognised by University during semester-1 to semester-5.
(The student need to enrol separately and pay the fees as decided by the respective institute/department)

Value Addition Course: As per NEP(National Education Policy-2020), it is mandatory for students to select a 2 credit Value Addition Course out of the choices given by the college/institute (From available basket of courses as per University norms). It will be mandatory for the student to opt minimum one 2-credit Value Addition Course out of offered courses recognised by the University during semester-1 to semester-4.
(The student need to enrol separately and pay the fees as decided by the respective institute/department)

 # Marks: : The students will enrol for the course from the given university approved list of certificate courses offered by the respective college/department. The student will select and enrol separately for any of the offered list of courses at college/department/institute and obtain respective credits. The institute will evaluate the performance (preferably continuous evolution) as per the SOP of certificate courses and on successfully completion of the course, the student will be eligible to obtain respective credits for the course. These credits will be considered and reflect in student's

mark-sheet as well as in ABC(Academic Bank of Credit). These courses are mandatory and student is required to obtain the specified credits in process to acquire the certificate/diploma/degree.
[The student is required to pay separately for these courses as prescribed by the college. The college will decide the fees for these courses based on the University norms of certificate course/credit fees.]

** Major Practical based Subjects: Course 303,304 and 305 are major courses consists of two components: Theory and Practical. These courses are carrying 4 credits.
Major courses carry 100 marks of exam weightage (50 theory and 50 practical). External and Internal distribution of marks are in ratio of 50:50 respectively. Students are required to acquire minimum passing marks from theory and practical collectively. All Practical exams for courses-302, course-303, course-304and course-305 will be of 2 hours duration.
External Theory/Practical exam marks (25 marks each for course-302, course-303, course-304 and course-305)
Division of marks for External Practical: Exam evaluation: 20 marks + Viva-voce: 5 Marks.
Students are required to pass in both components (Theory and Practical) collectively for course 302, 303,304 and 305 as combined head (Theory + Practical). It is mandatory for Students to appear for internal and external theory and practical exams for all courses. Similarly, In case a student remain absent in any of the component of Theory or Practical of major subject, the student will be considered fail.

Program Passing Rules:	As per University rules.
Program Fees : (Per Semester) (One time fees and exam fees are additional as prescribed by the university) (w.e.f. Academic Year : 2025-26)	Semester Tuition Fees : As per norms of University Semester Laboratory Utilization fees : As per norms of University [Other one time /affiliation /exam fees, will be as per the norms of the University] [The fees for all certificate courses, 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.]
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)

SEMESTER – 4

Course Code	Course Title	Course Category	Level of Course	Course Credits	Teaching per week	
					Theory	**Practical/ Fieldwork/Project/ Internship**
401	Organizational Soft-skills in Software Industry [Ability Enhancement Course-IV] (AEC-04)[%] [Modern Indian Language (MIL) & English language focused on language and communication skills.]	Ability Enhancement Course	200-299 Intermediate level	2	2	0
402-01 402-02	Internet of Things (IoT) User Interface and User Experience Design (UI/UX Design) (Student will opt any one minor course from the courses listed here)	Minor Course	200-299 Intermediate Level Course	4	4	0
403	Java Programming Language	Major Course	300-399	4	3	2
404-05	Machine Learning and Data Visualization	Major Course	300-399 Intermediate Level Course	4	2	4
405-05	Applied Artificial Intelligence with Open-Source Development Tools	Major Course	300-399 Intermediate Level Course	4	2	4
406	**Skill Enhancement Course-IV (SEC-04)** [The student will undergo field training/ internship training OR Select minimum one University approved and recognized 2 credit certificate course from the skill based courses list offered by the respective institute/department.] (The student need to enrol separately and pay the fees as decided by the respective institute/department)	Skill Enhancement Course	200-299 Intermediate Level Course	2	2	-
407	**Value Addition Course – IV (VAC-04)** [To be selected minimum one University approved and recognized 2 credit certificate course from the Value Addition Courses list offered by the respective institute/department.] (The student can select and enrol separately for the course offered by the respective institute/department and need to pay separately as decided by the institute as per norms of university for certificate courses.)	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

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)[%]	2	Presentation & Viva-voce	-	25	25	50
402-01 402-02	Internet of Things (IoT) User Interface and User Experience Design (UI/UX Design)	4	Theory/Written	2 Hours	50	50	100
403	Java Programming Language	4	Theory/ Written Practical	1 Hours 2 Hours	25 25	25 25	100
404-05	Machine Learning and Data Visualization	4	Theory/ Written Practical	1 Hours 2 Hours	25 25	25 25	100
405-05	Applied Artificial Intelligence with Open-Source Development Tools	4	Theory/ Written Practical	1 Hours 2 Hours	25 25	25 25	100
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, 404-05 and course-405-05. **Minimum** Ten Practical hours(2 Hours for course-403, 4 hours for course-404-05 and 4 hours for course-405-05) 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.

Major Course : Major discipline is the main focus (Core) dominant subject and the degree will be awarded in that discipline. Students must secure a prescribed number of credits (50% of total credits) through core courses in the major discipline. Students can choose the courses from the pool of courses. The number of courses (subjects) in Major may vary from semester to semester.

Minor Course : Minor discipline is the broader understanding course beyond the major discipline course. It contains generic-electives for students to choose from the pool of courses. It helps students to gain broader knowledge in addition to relevant major disciplines courses as per their choices. Minor subjects may be from same or different disciplines. Student may make choices according to their interest/need, from ODL courses also.

Interdisciplinary/Multidisciplinary/Allied Courses: This is constituent discipline of the major courses and it helps learners to acquire core competence in relevant or any other independent courses of their choices. This course may be major specific or other discipline specific. Learner shall have option to choose the course from available basket of approved courses provided by the university or from any other institutions as the learner's choice. The Credit allocated for these courses is 12 credits of total credits for 3 years' bachelor's degree and four years' bachelor's degree programme.

Internship: A student who wish to exit after successfully completion of first year (Semester-1 and Semester-2) without any backlog is required to obtain Four credits at the end of the year either through the summer internship or university approved skill based certificate courses(two courses of 2-credits each or one 4-credit course). Student is required to enrol for the certificate courses separately by paying the course fees as decided by the college/institute. For summer training, the Institute/college will grant the permission and evaluate the training outcomes. Based on satisfactory completion of the summer training, the Institute head will recommend to the university to grant four credits for summer training. The Internship/summer training/skill based certificate courses will be an audit course.[The internship cost/fees will be bear by the student.]

Ability Enhancement Course (AEC): To be offered to students to achieve competency in a Modern Indian Language and English Language focused on language and communication skills. It may be a major specific course. The Credit allocated for these courses is 10 credits of total credits for 3 years' bachelor's degree and four years' bachelor's degree programme. The courses can be selected by the college/institute from available basket of approved 2-credit certificate courses provided by the university.

Skill Enhancement 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 (From available basket of courses as per University norms). It will be mandatory for the student to opt minimum one 2-credit Skill enhancement course out of offered courses recognised by University during semester-1 to semester-5.
(The student need to enrol separately and pay the fees as decided by the respective institute/department)

Value Addition Course: As per NEP(National Education Policy-2020), it is mandatory for students to select a 2 credit Value Addition Course out of the choices given by the college/institute (From available basket of courses as per University norms). It will be mandatory for the student to opt minimum one 2-credit Value Addition Course out of offered courses recognised by the University during semester-1 to semester-4.
(The student need to enrol separately and pay the fees as decided by the respective institute/department)

 # Marks: : The students will enrol for the course from the given university approved list of certificate courses offered by the respective college/department. The student will select and enrol separately for any of the offered list of courses at college/department/institute and obtain respective credits. The institute will evaluate the performance (preferably continuous evolution) as per the SOP of certificate courses and on successfully completion of the course, the student will be eligible to obtain respective credits for the course. These credits will be considered and reflect in student's mark-sheet as well as in ABC(Academic Bank of Credit). These courses are mandatory and student is required to obtain the specified credits in process to acquire the certificate/diploma/degree.
[The student is required to pay separately for these courses as prescribed by the college. The college will decide the fees for these courses based on the University norms/SOP for certificate course/credit fees.]

** Major Practical based Subjects: Course 403,404-05 and 405-05 are major courses consists of two components: Theory and Practical. These courses are carrying 4 credits.
For Course-403 : 3 Hours of Theory and 2 hours of practical per week are allocated.
For Course 404-05 and 405-05, 2 Hours of theory and 4 hours of practical per week allocated.
Major courses carry 100 marks of exam weightage (50 theory and 50 practical). External and Internal distribution of marks are in ratio of 50:50 respectively. Students are required to acquire minimum passing marks from theory and practical collectively.
Practical exams for course-403 (2 hours duration), course-404(2 hours duration) and course-405(2 hours duration) will be conducted.
External Theory/Practical exam marks (25 marks each for course-403, course-404-05 and course-405-05)
Division of marks for External Practical: Exam evaluation: 20 marks + Viva-voce: 5 Marks.
Students are required to pass in both components (Theory and Practical) collectively for course 403,404-05 and 405-05 as combined head (Theory + Practical) for each major course. It is mandatory for Students to appear for internal and external theory and practical exams for all courses. Similarly, In case, a student remain absent in any of the component of Theory or Practical of major subject, the student will be considered fail.

Program Passing Rules:	As per University rules.
Program Fees : (Per Semester) (One time fees and exam fees are additional as prescribed by the university) (w.e.f. Academic Year : 2025-26)	Semester Tuition Fees : As per the norms of University Semester Laboratory Utilization fees : As per the norms of University [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 - 3

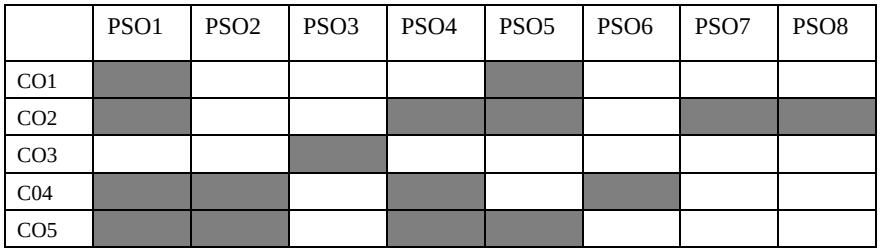
Course Code: 301

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)	
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 સિધ્ધાંતોની સુસંગતતા પર ચર્ચા. **Unit-3 : "સિંહપુરુષ" - લેખક : ડો. 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 .

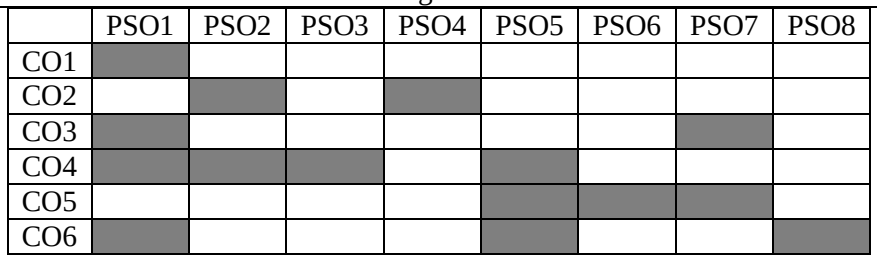
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■				■			
CO2	■			■	■		■	■
CO3			■					
C04	■	■		■		■		
CO5	■	■		■	■			

	- 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 દરમ્યાન 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 sahity 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)

[Subject Code-2511000903044002]

Course Code: 302-02
Course Title: Statistical Analysis using R

Course Code	302-02
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 of Theory + 4 Hours of Practical
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2025-2026
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 10th 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)	
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:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■							
CO2		■		■				
CO3	■						■	
CO4	■	■	■		■			
CO5					■	■	■	
CO6	■				■			■

	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, Publsher: Wiley, ISBN: 978-81-265-6872-2
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

[Subject Code for Theory- 2511000903011007]

[Subject Code for Practical-2511000903011008]

Course: 303-05: Fundamentals of Machine Learning

Course Code	303-05
Course Title	Fundamentals of Machine Learning
Credit	4
Course Category	Major Course
Level of Course	300 -399 (Higher Level)
Teaching per Week	2 Hours Theory + 4 Hours Lab.work
Minimum weeks/ Semester	15 (Including Class work, examination, preparation etc.)
Review / Revision	-
Implementation Year	A.Y.2025-2026
Medium of Instruction	English
Purpose of Course	The purpose of this course is to introduce B.C.A. students to the foundational concepts and practical applications of Machine Learning. It aims to build a clear understanding of data analysis, supervised learning techniques, and model evaluation through hands-on use of Python libraries. The course emphasizes both theoretical concepts and practical implementation, preparing students for real-world data-driven problem solving. By the end, students will be able to develop, test, and evaluate simple machine learning models independently.
Course Objective	**OB1:** Understand the foundational principles of artificial intelligence and machine learning, including types and real-world applications. **OB2:** Gain the ability to perform and automate exploratory data analysis (EDA) using Python libraries. **OB3:** Learn to apply linear and logistic regression techniques for data modeling and prediction. **OB4:** Develop a solid understanding of supervised learning algorithms and their key evaluation metrics. **OB5:** Build practical skills to address challenges like overfitting and underfitting through regularization and model validation techniques.
Pre-requisite	1) Basic knowledge of Python programming – including data types, loops, functions, and basic libraries like NumPy and Pandas. 2) Fundamentals of Mathematics and Statistics – especially linear algebra, probability, and descriptive statistics. 3) Familiarity with Data Handling – such as reading, writing, and cleaning data using tools like Excel or Python. 4) Basic Computer Literacy – understanding of file systems, command-line interface, and internet usage.
Course Out-come	**CO1:** Describe the fundamental concepts of artificial intelligence and machine learning, including types, benefits, and life cycle. **CO2:** Explain the process and importance of exploratory data analysis, and differentiate between various types of data and distributions. **CO3:** Apply Python libraries such as Pandas, NumPy, and visualization tools to automate EDA tasks. **CO4:** Develop predictive models using simple linear and logistic regression techniques. **CO5:** Analyze the performance of machine learning models using appropriate evaluation metrics like R^2, MSE, Precision, and Recall. **CO6:** Justify the use of model tuning techniques like regularization and cross-validation to avoid overfitting and underfitting.
Mapping between Course Outcomes(CO)	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

with Program Specific Outcomes(PSO)	

CO3								
CO4								
CO5								
CO6								

Course Content

Unit-1: Fundamentals of AI and Machine Learning

1.1 Concepts of Machine Learning
- 1.1.1 Understanding Machine Learning
- 1.1.2 Benefits of Machine Learning
- 1.1.3 Difference between AI, ML, and Deep Learning

1.2 Machine Learning Life Cycle
- 1.2.1 Stages of ML Life Cycle
- 1.2.2 Problem Definition to Model Monitoring

1.3 Exploratory Data Analysis (EDA)
- 1.3.1 Types of EDA
- 1.3.2 Univariate Analysis
- 1.3.3 Bivariate Analysis
- 1.3.4 Multivariate Analysis
- 1.3.5 Handling Missing Data
- 1.3.6 Detecting and Handling Outliers

1.4 Understanding the Data
- 1.4.1 Quantitative Data
  - 1.4.1.1 Discrete Data
  - 1.4.1.2 Continuous Data
- 1.4.2 Qualitative Data
  - 1.4.2.1 Nominal Data
  - 1.4.2.2 Ordinal Data

1.5 Spread of Data
- 1.5.1 Normal Distribution
- 1.5.2 Skewed Distribution
- 1.5.3 Skewness
- 1.5.4 Kurtosis

Unit-2: Automate EDA (Exploratory Data Analysis)

2.1 Python Libraries to Automate EDA
- 2.1.1 Pandas, NumPy. D-Tale
- 2.1.2 Pandas Profiling
- 2.1.3 Sweetviz AutoViz

2.2 Regression Fundamentals
- 2.2.1 Characteristics of Regression
- 2.2.2 Dependent and Independent Variables
- 2.2.3 Covariance
- 2.2.4 Correlation

2.3 Simple Linear Regression (SLR)
- 2.3.1 Understanding SLR
  - 2.3.1.1 Fitting a Straight Line ($y = mx + b$)
  - 2.3.1.2 Identifying Dependent and Independent Variables
- 2.3.2 Assumptions of SLR
  - 2.3.2.1 Linearity
  - 2.3.2.2 Independence of Errors
  - 2.3.2.3 Homoscedasticity
  - 2.3.2.4 Normality of Errors
- 2.3.3 Goodness of Fit
  - 2.3.3.1 R^2 and Adjusted R^2
  - 2.3.3.2 Significance of R^2 Value
  - 2.3.3.3 Residual Sum of Squares (RSS)

	Unit-3: Understanding Machine Learning 3.1 Types of Machine Learning 3.1.1 Supervised Learning 3.1.2 Unsupervised Learning 3.1.3 Applications of Machine Learning 3.2 Overview of Supervised Learning 3.2.1 Concepts of Supervised Learning 3.2.2 Classification vs. Regression 3.3 Basic Terminologies 3.3.1 Dataset 3.3.2 Features and Labels 3.3.3 Training, Testing, and Validation Data 3.3.4 Overfitting and Underfitting 3.4 Loss Functions 3.4.1 Mean Squared Error (MSE) 3.4.1.1 Definition of MSE 3.4.1.2 Computation and Properties 3.4.2 Mean Absolute Error (MAE) 3.4.2.1 Definition of MAE 3.4.2.2 Computation and Properties **Unit-4: Supervised Learning Algorithms** 4.1 Linear Regression (Review and Model Evaluation) 4.1.1 Model Fitting using Ordinary Least Squares (OLS) 4.1.2 Model Evaluation Techniques 4.1.2.1 R-squared 4.1.2.2 Mean Squared Error 4.1.2.3 Root Mean Squared Error (RMSE) 4.2 Logistic Regression 4.2.1 Sigmoid Function and Binary Classification 4.2.2 Cost Function and Gradient Descent 4.2.3 Multiclass Classification using Logistic Regression 4.2.3.1 One-vs-Rest Strategy 4.2.3.2 Softmax Function 4.3 Model Performance and Generalization 4.3.1 Overfitting 4.3.2 Underfitting 4.3.3 Avoiding Overfitting/Underfitting 4.3.3.1 Regularization (L1 and L2) 4.3.3.2 Cross-Validation 4.3.4 Evaluation Metrics 4.3.4.1 Accuracy 4.3.4.2 Precision 4.3.4.3 Recall 4.3.4.4 F1 Score
Reference Books	1) Machine Learning, T.V. Vijay Kumar, BS Publications, ISBN:9789381075614 2) Fundamentals of Machine Learning for Predictive Data Analytics, K.P. Soman, R. Loganathan, V. Ajay, PHI Learning Pvt. Ltd., ISBN: 9788120350786 3) Programming in Python, Dr. Rakesh K. Jain, University Science Press (Laxmi Publications), 9789386768016 4) Data Analytics with Python, Suresh Samudrala, V. Rajaraman, PHI Learning Pvt. Ltd., 9789353062026 5) Introduction to Machine Learning, Alok Sharma, Narosa Publishing House, 9788184874535 6) Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 9780387310732

	7) Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly Media, 9781098125974 8) Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press, 9780262018029 9) Python Machine Learning, Sebastian Raschka, Vahid Mirjalili, Packt Publishing, 9781800567708 10) The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer, 9780387848570
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

[Subject Code for Theory-2511000903022007]
[Subject code for Practical-2511000903022008]

Course Code: 304-05

Course Title: AI-Oriented Programming and Data Structures in Python (A.I.O.P.D.)

Course Code	304-05
Course Title	AI-Oriented Programming and Data Structures in Python (A.I.O.P.D.)
Credits	4
Course Category	Major Course
Level of Course	300-399 (Higher Level)
Teaching per Week	3 Hours Theory + 2 Hours Practical work
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	A.Y. 2025-2026
Course Objective	**OB1:** To introduce the fundamentals of Object-Oriented Programming using Python, with emphasis on concepts like encapsulation, inheritance, and polymorphism, and their relevance in AI-based programming. **OB2:** To develop a strong foundation in core data structures such as stacks, queues, trees, and sorting algorithms essential for efficient data handling and AI problem-solving. **OB3:** To equip students with AI problem-solving methodologies including uninformed and informed search strategies, logic representation, and inference mechanisms. **OB4:** To enable hands-on implementation of AI algorithms and techniques using Python libraries and tools through practical exercises and mini projects. **OB5:** To foster an understanding of real-world AI applications through the study of expert systems, decision trees, and case studies on widely used AI tools like ChatGPT, Teachable Machine, and IBM Watson.
Pre-requisite	Basic understanding of Python programming, including variables, control structures, and functions. Familiarity with elementary statistics, logic, and problem-solving techniques will be beneficial for understanding core AI concepts and data structure implementations.
Course Outcomes	**CO1:** *Describe* object-oriented programming principles and linear/non-linear data structures using Python. (Remembering, Understanding) **CO2:** *Implement* stacks, queues, sorting algorithms, and trees to solve structured computational problems in AI. (Applying) **CO3:** *Apply* various uninformed and informed AI search strategies to model and solve state-space and constraint satisfaction problems. (Applying, Analyzing) **CO4:** *Analyze* knowledge representation schemes and logic-based reasoning for intelligent decision-making systems. (Analyzing, Evaluating) **CO5:** *Develop* practical AI solutions using Python-based tools and libraries by integrating rule-based systems, logic engines, and modern AI platforms. (Creating)
Mapping between Course Outcomes(CO) with Program Specific Outcomes(PSO)	
Course Content	**Unit-1 : Basics of Object Oriented Programming:** 1.1 Concepts of Class and Object in Python (Defining classes, objects, and the self-keyword) 1.2 Data Encapsulation and Inheritance:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								
CO4								
CO5								

	1.2.1 Access control concepts (Public, Private, Protected) and their difference in Python 1.2.2 Declaring simple class, member variables, and member functions in Python 1.2.3 Concepts of Data hiding, abstraction, and encapsulation in Python. 1.2.4 Concepts of Inheritance in Python and types of inheritance (Single, Multiple, Multilevel) 1.2.5 Constructors (__init__) and Destructors (__del__) in Python 1.3 Polymorphism: 1.3.1 Concepts of Polymorphism in Python 1.3.2 Compile-time and run-time Polymorphism in Python 1.3.3 Method Overloading and Overriding in Python: Concepts, difference, and application 1.4 Introduction to Data Structures and their application areas in Python (using lists, sets, tuples, dictionaries) 1.4.1 Difference between Linear and Non-Linear Data Structures in Python **Unit-2 : Data Structure fundamentals for A.I.:** 2.1 Stack: 2.1.1 Concepts of Stack (LIFO) 2.1.2 Push, Pop, and Display operations 2.1.3 Application areas of Stack in Python (Infix to Postfix conversion, Postfix to Infix) 2.2 Queue: 2.2.1 Concepts of Queue (FIFO) 2.2.2 Implementation of Queue in Python: 2.2.2.1 Simple Queue: insert, delete, and display using lists 2.2.2.2 Double-ended Queue (Deque): insert, delete, and display using collections.deque 2.3 Understanding Sorting algorithms: 2.3.1 Concepts of sorting and its time complexity 2.3.2 Implementation of Selection Sort, Bubble sort and Quick sort using Python library functions and modules. 2.4 Concepts of Trees: 2.4.1 Definition of a tree, root, leaf, and internal nodes 2.4.2 Concepts of Binary Tree, Binary Search Tree (BST) and AVL Tree **Unit-3: AI Problem Solving Techniques** 3.1 Problem Formulation in AI 3.1.1 State-space representation 3.1.2 Components: Initial state, goal state, operators 3.2 Uninformed Search Strategies 3.2.1 Breadth-First Search (BFS) 3.2.2 Depth-First Search (DFS) 3.2.3 Uniform Cost Search 3.3 Informed Search Strategies 3.3.1 Heuristics and Evaluation Functions 3.3.2 Best-First Search, A* Search 3.4 Constraint Satisfaction Problems (CSP) 3.4.1 Variables, domains, constraints 3.4.2 Backtracking and forward checking 3.5 Understanding Intelligence through Logic and Knowledge 3.5.1 Knowledge Representation Techniques 3.5.2 Propositional logic 3.5.3 First-order logic 3.5.4 Semantic networks and frames 3.6 Reasoning and Inference 3.6.1 Inference rules and resolution 3.6.2 Forward and backward chaining

	UNIT-4: Practical Applications of AI using Python 4.1 Rule-Based Expert Systems 4.1.1 Architecture of expert systems 4.1.2 Case study: MYCIN or any rule-based system 4.2 Implementing Search Algorithms using Python Libraries 4.2.1 BFS and DFS using Python 4.2.2 A* Search implementation 4.3 Implementing Logic and Rule-Based Systems 4.3.1 Creating a simple rule-based chatbot 4.3.2 Inference using forward chaining 4.3.3 Creating a simple rule-based chatbot using Python 4.3.3.1 Demonstrating forward chaining using a rule engine (e.g., PyKnow) 4.4 Case Study on Real-World AI Tools 4.4.1 Case Study 1: ChatGPT and Google Gemini – Conversational AI overview and its working principles 4.4.2 Case Study 2: Teachable Machine by Google – Building custom image/sound classification model without code 4.4.3 Case Study 3: IBM Watson – Understanding applications in healthcare, customer service, and business analytics [Students are expected to work on a Mini Project during lab hours designing AI based application Considering follows guide-liens: (i) Define a problem (e.g., chatbot, recommender, image classifier) (ii) Design and implement using Python or any AI tool (iii) Submit report with screenshots and working demo]
Reference Books	1)Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, Pearson, ISBN: 978-0136042594 2) Python Programming: An Introduction to Computer Science, John Zelle, Franklin, Beedle & Associates Inc., ISBN: 978-1590282410 3) Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley, ISBN: 978-1118290279 4) Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, Prentice Hall, ISBN: 978-0132550707 5) Python Machine Learning, Sebastian Raschka, Vahid Mirjalili, Packt Publishing, ISBN: 978-1789955750 6) Fundamentals of Artificial Intelligence, N. P. Padhy, Prentice Hall India, ISBN: 978-8120328805 7) Programming in Python 3, Mark Summerfield, Addison-Wesley, ISBN: 978-0321680563 8) Artificial Intelligence: Principles and Techniques, Nils J. Nilsson, Morgan Kaufmann, ISBN: 978-1558604674 9) Data Structures Using Python, Rance D. Necaise, Wiley, ISBN: 978-1118957321 10) Artificial Intelligence: A New Synthesis, Nils J. Nilsson, Morgan Kaufmann, ISBN: 978-1558604674 11) Python for Data Analysis, Wes McKinney, O'Reilly Media, ISBN: 978-1491957660 12) Machine Learning Using Python, Manaranjan Pradhan, BPB Publications, ISBN: 978-9388519004
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

[Subject code for Practical-2411000903033002]

Course Code: 305-05

Course Title: Web Designing-I

[Subject Code for Theory-2411000903033001]

Course Code	305-05
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. 2025-2026
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: HTML5 and CSS for Web Design

1.1 Concepts of CSS:
- 1.1.1 Adding CSS (Inline, Internal, External)
- 1.1.2 HTML Links and attributes (_self, _blank, _parent, _top)
- 1.1.3 Absolute URL and Relative URL in <href>
- 1.1.4 <img> 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, checkbox, 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 and Audio

UNIT 2: Responsive Design Using Bootstrap 4

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

UNIT 3: JavaScript Basics and Control Structures

3.1 Overview of Client & Server-Side Scripting
3.2 Structure of JavaScript
3.3 Data Types and Variables
3.4 Operators:
3.4.1 Arithmetic, Assignment, Comparison
3.4.2 Logical and Conditional Operators
3.5 Control Structures:
3.5.1 if…else, switch…case
3.5.2 while, do…while, for loop
3.5.3 break, continue
3.6 JavaScript Strings and Events:
3.6.1 JavaScript String 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, mouseout, mouseup
3.6.3.2 Keyboard Events: keyup, keydown
3.6.3.3 Form Events: focus, submit, blur, change

UNIT 4: Advanced JavaScript and DOM Manipulation

4.1 JavaScript Objects:
4.1.1 Creating Object (By literal, instance, 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 JavaScript Functions:
4.3.1 Defining Functions (with and without parameters)
4.3.2 Calling Functions
4.3.3 Return Statement
4.3.4 Page Redirection
4.4 Dialog Boxes and Form Validation:
4.4.1 Dialog Boxes: alert, confirm, prompt
4.4.2 Form Validation:
4.4.2.1 Basic Validation (All form details are filled)
4.4.2.2 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 Unleased, Darnell Rick –Techmedia 3. HTML, XHTML, and CSS Bible - Steven M. Schafe – Wiley Publications 4. Cascading Style Sheets- The Definitive Guide, E. A Meyer –O'Reilly 5. Java Scripting 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. 50% External assessment.

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. 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 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.

[Subject code -2511000903070002]

Course code: 307

Course Title: Indian Knowledge System in context to Computers – 01(VAC-03)

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. 2025-2026
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 Suryasidhdhanta by Aryabhatt:
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).

[Subject Code-2511000904055001]

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. 2024-2025
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.(10th) 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: HarperBusiness, 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%)

[SUbject code-2511000904044001]

Course Code : 402-01 Course Title: IoT (Internet of Things)	
Course Code	**402-01**
Course Title	**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	A.Y. 2023-2024
Implementation Year:	A.Y. 2024-2025
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

Unit 5. Case Study

5.1 IoT for Smart city applications
5.2 IoT for Smart Home
5.3 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. 50% External assessment.

[Subject Code-2511000904044002]

Course Code: 402-02

Course Title: User Interface and User Experience Design (UI/UX Design)

Course Code	402-02
Course Title	User Interface and User Experience Design (UI/UX Design)
Credits	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.)
Review / Revision	-
Implementation Year:	A.Y. 2024-2025
Purpose of Course	This course introduces UI/UX design principles, methodologies, and practical skills, preparing students for further exploration and specialization in the field. The purpose of a UI/UX course is to equip students with the knowledge, skills, and techniques necessary to design user interfaces and experiences that are intuitive, engaging, and effective. Through a combination of theoretical understanding and practical application, students learn to create user-centric designs that enhance usability, accessibility, and user satisfaction. The course covers topics such as user research, information architecture, interaction design, visual design, and usability testing, providing a comprehensive foundation in the principles and best practices of UI/UX design. By mastering these skills, students are prepared to pursue careers in various industries, contributing to the creation of seamless and enjoyable digital experiences for users.
Course Objective	i) Understand the Basics of UI/UX Design: Introduction to the fundamental principles and concepts of user interface (UI) and user experience (UX) design, including the difference between UI and UX, the importance of user-centered design, and the role of UI/UX in product development. ii) Learn User Research Methods: Familiarize with basic user research methods, such as user interviews, surveys, and observation techniques, to understand user needs, behaviors, and preferences. iii) Create Wireframes and Prototypes: Learn how to create low-fidelity wireframes and prototypes using simple design tools or pen and paper to visualize the structure and layout of digital interfaces. iv) Explore Interaction Design Principles: Introduction to interaction design principles, including affordances, feedback, and user flows, to design intuitive and responsive user interfaces that facilitate user interaction and navigation. v) Conduct Usability Testing: An overview of usability testing methods and techniques, such as heuristic evaluations and user testing sessions, to evaluate the effectiveness and usability of UI designs and gather feedback for iteration and improvement.
Pre-requisite	-
Course Outcomes	**CO1:** Provide students with a foundational understanding of user interface (UI) and user experience (UX) design principles, including usability, accessibility, and user-centered design. **CO2:** Familiarize students with basic user research methodologies, such as user interviews, surveys, and personas, to identify user needs, behaviors, and preferences. **CO3:** Develop students' ability to create low-fidelity wireframes and prototypes using industry-standard tools or pen and paper, enabling them to visualize and communicate design concepts effectively.

CO4: Introduce students to interaction design principles, including affordances, feedback, and user flows, to design intuitive and responsive digital interfaces that facilitate user interaction and engagement.
CO5: Explore fundamental principles of visual design, such as typography, color theory, and layout, to create aesthetically pleasing and visually coherent UI designs that enhance user experience.
CO6: Teach students how to plan and conduct usability testing sessions, analyze feedback, and iterate on designs to improve usability and user satisfaction, ensuring that designs meet user needs and expectations.

	PS01	PS02	PS03	PS04	PS05	PS06	PS07	PS08
CO1	■		■					
CO2	■						■	
CO3					■			
CO4	■		■	■			■	■
CO5	■		■	■	■	■		
CO6		■		■		■		■

Course Content

Unit 1: Introduction to UI/UX Design:

1.1 Overview of UI/UX Design and understanding the role of UI/UX design in product development.
1.2 Introduction to user-centered design principles and methodologies.
1.3 Exploring the significance of UI/UX in enhancing user satisfaction and product success.

Unit 2: User Research and Analysis:

2.1 Importance of user research in informing design decisions.
2.2 Creating user personas to represent target users and their needs.
2.3 Techniques for conducting effective user interviews to gather insights and feedback.
2.4 Overview of usability testing methods and techniques for evaluating design prototypes.

Unit 3: Interaction Design and Information Architecture:

3.1 Principles of Interaction Design (affordances, feedback, and user flows).
3.2 Understanding information architecture and organizing content for intuitive navigation.
3.3 Techniques for creating low-fidelity wireframes and interactive prototypes to visualize design concepts.
3.4 Understanding designing effective navigation systems to facilitate user interaction and exploration.

Unit 4: Visual Design Essentials:

4.1 Basics of Visual Design (typography, color theory, and layout).
4.2 Visual hierarchy to guide user attention and emphasize important content.
4.3 Iconography and Imagery to enhance user understanding and engagement.
4.4 Importance of branding and maintaining consistency across UI elements for a cohesive user experience.

Unit 5: Usability Testing , Iteration and case study:

5.1 Usability Testing Process (planning, conducting, and analyzing usability testing sessions).
5.2 Iterative design process and User feedback for continuous improvement.
5.3 Designing for accessibility
5.4 Case study

Reference Books

1. "Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability", Author: Steve Krug, Publisher: New Riders, ISBN: 978-0321965516

2. "The Design of Everyday Things: Revised and Expanded Edition", Author: Don Norman, Publisher: Basic Books, ISBN: 978-0465050659

	3. "100 Things Every Designer Needs to Know About People", Author: Susan Weinschenk, Publisher: New Riders, ISBN: 978-0321767530 4. "About Face: The Essentials of Interaction Design", Author: Alan Cooper, Robert Reimann, and David Cronin, Publisher: Wiley India, ISBN: 978-8126556744 5. "The Elements of User Experience: User-Centered Design for the Web and Beyond", Author: Jesse James Garrett, Publisher: Pearson India, ISBN: 978-8131707918 6. "Universal Principles of Design, Revised and Updated", Author: William Lidwell, Kritina Holden, and Jill Butler, Publisher: Rockport Publishers India, ISBN: 978-1631596226 7. "The UX Book: Process and Guidelines for Ensuring a Quality User Experience", Author: Rex Hartson and Pardha S. Pyla, Publisher: Pearson India, ISBN: 978-9332518320 8. "Lean UX: Designing Great Products with Agile Teams", Author: Jeff Gothelf and Josh Seiden, Publisher: Wiley India, ISBN: 978-8126561977 9. "Designing for Interaction: Creating Innovative Applications and Devices", Author: Dan Saffer, Publisher: Pearson India, ISBN: 978-8131705648 10. "Designing Interfaces: Patterns for Effective Interaction Design", Author: Jenifer Tidwell, Publisher: O'Reilly India, ISBN: 978-8184045881 11. "Designing Web Interfaces: Principles and Patterns for Rich Interactions", Author: Bill Scott and Theresa Neil, Publisher: O'Reilly India, ISBN: 978-8184045799
Teaching Methodology	Class Work, Discussion, Self-Study, Case-study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

[Subject code for Theory-S2511000904011001]

Course Code: 403

Course Title: Java Programming Language

[Subject code for Practical-2511000904011002]

Course Code	403
Course Title	Java Programming Language
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	2023-2024
Implementation Year:	A.Y. 2024-2025
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)	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■		■	■		■		
CO2	■	■			■			
CO3	■			■			■	
CO4			■			■		■
CO5	■			■		■	■	■

Course Content	**Unit 1. Introduction to Java** 1.1 Properties of Java 1.2 Comparison of java with C++ 1.3 Java Compiler, Java Interpreter 1.4 Identifier, Literals, Operators, Variables, Keywords, Data Types 1.5 Branching: If – Else, Switch 1.6 Looping: While, Do-while, For 1.7 Type Casting **Unit 2. Classes and Objects** 2.1 Simple Class, Field 2.2 Access Controls, Object creation 2.3 Construction and Initialization

	2.4 Inheritance and Polymorphism in Java 2.4.1 Data encapsulation, overriding and overloading methods 2.5 this and super keywords 2.6 Static members, static block, static class 2.7 Interfaces: 2.7.1 Introduction to Interfaces, Interface Declaration. 2.7.2 Inheriting and Hiding Concepts. 2.7.3 Inheriting, Overloading and Overriding Methods and constructors. 2.7.4 Interfaces Implementations. **Unit 3. Basic Concepts of Strings and Exceptions :** 3.1 Strings 3.1.1 Basic String operations, String Comparsion 3.1.2 String methods (charAt(), concat(), equals(), indexOf(), isEmpty(), join(), lastIndexOf(), length(),split(), substring(),trim()) 3.1.3 StringBuffer class and its constructors. 3.1.4 StringBuffer methods : (append(),insert(),update(), delete(), reverse(),capacity()) 3.2 Introduction to Exceptions: 3.2.1 Exception Types, User defined Exception 3.2.2 Throw, Throws 3.2.3 Try, Catch and Finally **Unit 4. Threads and Packages:** 4.1 Thread 4.1.1 Introduction to Threads, Thread Model 4.1.2 Priority of Threads 4.2 Package Naming, Type Imports 4.2.1 Package Access, Package Contents 4.2.2 Package Object and Specification **Unit 5. Data Structure Implementation using Java Class** 5.1 Implementation of Data Structure using Java Class: 5.1.1 Concepts of singly and singly circular link-list 5.1.2 Singly Link List : Create, traverse, insert, delete node 5.1.3 Singly circular link list: create, traverse, insert, delete node.
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. 50% External assessment.

[Subject code for Theory-2611000904022007]

Course Code: 404

Course Title: Machine Learning and Data Visualization

[Subject code for Practical-2611000904022008]

Course Code	404
Course Title	Machine Learning and Data Visualization
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. 2025-2026
Purpose of Course	This course aims to provide in-depth knowledge of advanced supervised and unsupervised machine learning algorithms. Students will gain hands-on experience in classification, clustering, and model optimization techniques using Python. The course emphasizes practical applications, real-world datasets, and interpretable model building. By the end, learners will be capable of executing and deploying end-to-end machine learning solutions.
Course Objective	**Ob-1:** To provide a comprehensive understanding of advanced classification algorithms such as Decision Trees, Random Forest, KNN, and Naïve Bayes. **Ob-2:** To introduce students to unsupervised learning techniques like K-Means, Hierarchical Clustering, and DBSCAN, along with their practical applications. **Ob-3:** To develop competency in model optimization through cross-validation methods, hyperparameter tuning, and regularization techniques. **Ob-4:** To explain the importance of feature selection and guide students in using effective feature selection methods in machine learning models. **Ob-5:** To enable students to carry out end-to-end machine learning projects using real-world datasets and deploy their models using tools such as Flask and Streamlit.
Pre-requisite	A basic understanding of supervised learning algorithms, data preprocessing, and evaluation metrics is essential. Prior knowledge of Python programming and libraries such as Pandas, NumPy, and Scikit-learn is recommended.
Course Outcomes	**CO1:** Understand and explain the working principles of advanced supervised and unsupervised machine learning algorithms. **CO2:** Apply appropriate classification or clustering techniques to solve real-world problems using structured datasets. **CO3:** Analyze model performance using cross-validation, tuning, and evaluation metrics to improve prediction accuracy. **CO4:** Evaluate feature importance and apply regularization and feature selection techniques to optimize models. **CO5:** Design, implement, and deploy complete machine learning solutions using real-world case studies and Python tools.
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: Advanced Supervised Learning – Classification Algorithms** 1.1 Decision Trees 1.1.1 Concept and Working of Decision Trees 1.1.2 Gini Index, Entropy, and Information Gain 1.1.3 Overfitting and Pruning in Decision Trees 1.2 Random Forest 1.2.1 Introduction to Ensemble Learning 1.2.2 Bagging Concept 1.2.3 Random Forest Algorithm 1.2.4 Feature Importance in Random Forest 1.2.5 Use-case: Predicting Customer Churn using Python 1.3 K-Nearest Neighbors (KNN) 1.3.1 Distance Metrics (Euclidean, Manhattan) 1.3.2 Choosing the Value of K 1.3.3 Strengths and Weaknesses of KNN 1.4 Model Optimization 1.4.1 Hyperparameter Tuning 1.4.2 Cross-validation in Practice 1.4.3 Understanding Overfitting and underfitting 1.5 Support Vector Machines (SVM) 1.5.1 Concept of Hyperplanes and Margins 1.5.2 Linear vs Non-Linear Classification 1.5.3 Kernel Trick and Common Kernels (RBF, Polynomial) 1.5.4 Pros and Cons of SVM **Unit-2: Unsupervised Learning – Clustering Techniques** 2.1 Introduction to Unsupervised Learning 2.1.1 Use Cases and Applications 2.1.2 Challenges of Unsupervised Learning 2.2 K-Means Clustering 2.2.1 Algorithm Steps 2.2.2 Choosing the Number of Clusters (Elbow Method) 2.2.3 Limitations of K-Means 2.2 DBSCAN (Density-Based Clustering) 2.3.1 Concepts of Core, Border, and Noise Points 2.3.2 Parameters: eps and min_samples 2.3.3 Comparison with K-Means 2.5 Model Optimization and Tuning 2.5.1 Cross-Validation Techniques with Hyperparameter Search 2.5.2 K-Fold Cross-Validation 2.5.3 Stratified K-Fold 2.5.4 Leave-One-Out Cross-Validation **UNIT 3: Real-World Applications and Deployment** 3.1 Case-Based Learning 3.1.1 Predictive Analytics in Healthcare 3.1.2 Credit Risk Analysis in Banking 3.1.3 Movie Recommendation Engine (Collaborative Filtering) 3.2 Model Deployment Basics 3.2.1 Saving and Loading Models (Pickle and Joblib) 3.2.2 Using Flask for Creating Python APIs 3.2.3 Simple Model Deployment on Localhost 3.3 Introduction to MLOps 3.3.1 Basics of MLOps and its Importance 3.3.1.1 Understanding MLOps(Machine Learning Operations) 3.3.1.2 Importance in real-world ML project lifecycle 3.3.1.3 Comparison of traditional ML vs MLOps lifecycle 3.3.1.4 Key benefits: automation, reproducibility, monitoring

	3.4 Case Discussion: End-to-End ML Pipeline 3.4.1 Case Study: A spam detection model for an email system 3.4.2 Data ingestion (daily incoming emails) 3.5 Applied Machine Learning and Case Studies 3.5.1 End-to-End ML Project Workflow 3.5.2 Problem Definition to Deployment 3.5.3 Data Splitting, Preprocessing, Modeling, Evaluation 3.6 Working with Real-World Datasets 3.6.1 UCI and Kaggle Datasets Use Cases 3.6.2 Basics of Text and Image Classification 3.7 Model Evaluation and Interpretation 3.7.1 Confusion Matrix 3.7.2 ROC Curve and AUC 3.7.3 Precision-Recall Trade-off **UNIT 4: Data Visualization and Storytelling** 4.1 Principles of Effective Data Visualization 4.1.1 What Makes a Visualization Effective 4.1.2 Understanding the audience 4.1.2.1 Clarity, accuracy, and simplicity 4.1.3 Storytelling with visuals 4.1.3 Types of Charts and When to Use Them 4.1.3.1 Bar chart, Line graph, Histogram 4.1.3.2 Pie chart, Box plot, Heatmap 4.1.3.3 Tree map, Scatter plot, Bubble chart 4.2 Power BI and Tableau for Business Intelligence 4.2.1 Overview and comparison of Tableau vs Power BI 4.2.2 Installing and setting up Power BI Desktop and Tableau Public 4.3 Connecting to datasets using PowerBI: Excel, CSV, Web, SQL Server 4.3.1 Building Visual Reports 4.3.2 Designing dashboards with multiple visuals 4.3.3 Creating calculated fields and DAX (Power BI) 4.3.4 Filters, slicers, and drill-through capabilities 4.4 Creating interactive dashboards with user input using PowerBI 4.4.1 Publishing and Sharing Reports using PowerBI 4.4.2 Sharing links and embedding dashboards [Suggested Practical work : Students will create a mini-project on following during Practical hours: 1) Sales Dashboard: Analyze sales performance of a company 2) Weather Data Visualization: Plot temperature trends across cities 3) AQI Dashboard: Visualize Air Quality across metro cities 4) Education Insights: Analyze pass rates, dropout trends, etc. Final Expected Deliverables are: i) Cleaned dataset ii) Python-based EDA report iii) BI tool dashboard iv) Short presentation explaining the story behind the data]
Reference Books	1) Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Aurélien Géron, ISBN: 978-1098125974 2) Pattern Recognition and Machine Learning, Springer, Christopher M. Bishop, ISBN: 978-0387310732 3) Python Machine Learning, Packt Publishing, Sebastian Raschka, Vahid Mirjalili, ISBN: 978-1801819312 4) Data Science for Business, O'Reilly Media, Foster Provost, Tom Fawcett, ISBN: 978-1449361327 5) Storytelling with Data: A Data Visualization Guide for Business Professionals, Wiley, Cole Nussbaumer Knaflic, ISBN: 978-1119002253

	6) Machine Learning, McGraw Hill Education India, Tom M. Mitchell (Adapted Edition), ISBN: 978-9339222724 7) Data Visualization and Dashboarding, BPB Publications, Ajoy Kumar Ray, ISBN: 978-9391392971 8) Artificial Intelligence and Machine Learning, PHI Learning, Pratap K. Dixit, ISBN: 978-9391818518 9) Data Science and Machine Learning using Python, BPB Publications, Srinivas Reddy, ISBN: 978-9389898752 10) Business Intelligence and Analytics using Power BI, Wiley India, G. Nagarjuna, Ramesh Babu, ISBN: 978-8126578914
Teaching Methodology	Class Work, Discussion, Lab work, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

[Subject code for Theory-2611000904033009]

[Subject code for Practical-2611000904033010]

Course: 405-05: Applied Artificial Intelligence with Open-Source Development Tools

Course Code	405-05
Course Title	Applied Artificial Intelligence with Open-Source Development Tools
Credit	4
Course Category:	Major Course
Level of Course:	300- 399 (Higher Course)
Teaching per Week	2 Hours Theory + 4 Hours of Lab. Work
Minimum weeks per Semester	15 (Including class work, examination, preparation etc.)
Review / Revision	-
Implementation Year:	2025-2026
Purpose of Course	The purpose of this course is to equip students with hands-on, practical knowledge in the field of Artificial Intelligence using widely adopted open-source tools and frameworks. It aims to bridge the gap between theoretical AI concepts and real-world applications by enabling learners to design, develop, and deploy AI-based solutions using Python, machine learning libraries, chatbot frameworks, and data visualization platforms. The course emphasizes skill-building through practical labs, case studies, and mini-projects focused on automation, natural language interaction, and data-driven decision-making.
Course Objective	OB1: Understand the role and application of open-source AI tools in real-world domains. OB2: Develop and deploy machine learning models using Python-based tools. OB3: Analyze and process natural language data using NLP libraries. OB4: Design, build, and deploy rule-based and AI-based chatbots using open-source platforms. OB5: Apply practical knowledge through mini-projects involving real datasets and chatbot use-cases.
Pre-requisite	Basic understanding of programming using Python, including data types, functions, and control structures. Familiarity with foundational concepts of machine learning, supervised/unsupervised algorithms, and experience using Python libraries such as NumPy, Pandas, and Matplotlib is essential.
Course outcome	**CO1:** Identify and explain open-source tools used in AI applications. (Remembering, Understanding) **CO2:** Implement AI models using Python libraries and visualize results using dashboards. (Applying) **CO3:** Analyze natural language data using open-source NLP frameworks. (Analyzing) **CO4:** Design and build rule-based and AI-based chatbots using Python and Rasa. (Creating) **CO5:** Evaluate the chatbot model performance and enhance interaction through testing and feedback. (Evaluating)

Mapping between Course Outcome(CO) and Program Specific Outcome (PSO):

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	■		■	■		■		
CO2	■	■			■			
CO3	■			■			■	
CO4			■			■		■
CO5	■			■		■	■	■

Course Content	**UNIT 1: Introduction to Applied Artificial Intelligence and Open-Source Tools** 1.1 Understanding Applied AI 1.1.1 Difference between Theoretical AI vs. Applied AI 1.1.2 Use Cases of AI in Industries (Healthcare, Education, Finance, Marketing) 1.2 Overview of Open-Source AI Tools 1.2.1 What is Open Source in AI? 1.2.2 Advantages and Limitations of Open-Source Tools 1.2.3 Community, Licensing, and Support 1.3 Introduction to AI Tools for Data Preparation and Modeling 1.3.1 Google Colab and Jupyter Notebook 1.3.2 Scikit-learn for Machine Learning 1.3.3 OpenAI Gym for Reinforcement Learning Basics 1.3.4 Introduction to Hugging Face Transformers 1.4 Case Studies 1.4.1 AI in Retail: Predicting Customer Purchase 1.4.2 AI in Healthcare: Disease Diagnosis System **UNIT 2: Practical Exploration of Open-Source AI Tools** 2.1 Natural Language Processing Tools 2.1.1 SpaCy and NLTK: Text Cleaning and Tokenization 2.1.2 Sentiment Analysis using TextBlob 2.1.3 Named Entity Recognition with SpaCy 2.2 AI Model Development Tools 2.2.1 TensorFlow and Keras: Building a Simple Neural Network 2.2.2 AutoML Tools: H2O.ai and MLJAR 2.2.3 MLFlow for Model Tracking and Experimentation 2.3 Open-Source AI Visualization Tools 2.3.1 Streamlit: Creating AI-powered Web Apps 2.3.2 Gradio: Deploying AI Models with GUI [Recommended Lab : (i) Build and deploy a Sentiment Analyzer (ii) Create an AI-powered dashboard using Streamlit] **UNIT 3: Introduction to Chatbots and Their Applications** 3.1 Understanding Chatbot 3.1.1 Types of Chatbots: Rule-Based and AI-Based 3.1.2 Chatbot Architecture 3.1.3 Chatbots in Business and Customer Support 3.2 Designing Chatbot Workflows 3.2.1 Defining User Intents and Responses 3.2.2 Creating Dialog Flows 3.2.3 Handling FAQs and User Context 3.3 Tools for Chatbot Development 3.3.1 Rasa: Open-Source AI Chatbot Framework 3.3.2 ChatterBot: Rule-based Chatbots in Python 3.3.3 Dialogflow (overview and comparison with open-source tools) 3.4 Real-Life Examples and Use Cases using Rasa or ChatterBot 3.4.1 Chatbots in E-commerce 3.4.2 Educational Bots 3.4.3 Healthcare Assistants **UNIT 4: Practical Chatbot Development Using Python** 4.1 Building a Rule-Based Chatbot using ChatterBot 4.1.1 Using ChatterBot with Python 4.1.2 Training Chatbot with Corpus Data 4.1.3 Deploying on Localhost or Streamlit 4.2 AI-Based Chatbot with Rasa 4.2.1 Installation and Configuration of Rasa 4.2.2 Defining Domain, NLU, and Stories 4.2.3 Creating Custom Actions and Webhooks

	4.2.4 Deploying Rasa Chatbot in Web Application 4.3 Integration and Testing 4.3.1 Integrating Chatbot with Web UI (Rasa UI or HTML + Flask for frontend) 4.3.2 Testing and Improving UX (Rasa shell NLU, conversation tests) 4.3.3 Logging and Analytics (Rasa supports conversation trackers and logging) 4.4 Developing Mini Project: End-to-End Chatbot Development 4.4.1 Use cases (Helpdesk Bot / Health Assistant / Feedback Bot) 4.4.2 Design, Build, Train, and Deploy Chatbot 4.4.3 Project with Live Demo and Report
Lab Exercises:	Lab 1: Building a Rule-Based Chatbot with ChatterBot Objective: Create a simple rule-based chatbot using Python. Tasks: Install ChatterBot and dependencies. Create a chatbot instance. Train chatbot with ChatterBot's English corpus data. Test chatbot responses with sample queries. Deploy chatbot on localhost using Streamlit interface. Deliverable: Functional chatbot answering basic questions. Lab 2: Custom Training and Improving ChatterBot Responses Objective: Customize chatbot training for specific domain. Tasks: Prepare a small custom corpus related to a chosen domain (e.g., library assistant). Train ChatterBot with custom corpus. Evaluate chatbot's response accuracy. Implement conversation logging to analyze interactions. Deliverable: Domain-specific chatbot with improved response accuracy. Lab 3: Installing and Setting Up Rasa Environment Objective: Set up Rasa on local machine. Tasks: Install Rasa and dependencies. Initialize a new Rasa project. Explore folder structure and key files (domain.yml, config.yml, data folder). Deliverable: Running Rasa project ready for development. Lab 4: Defining NLU Components and Intents in Rasa Objective: Build intent recognition model. Tasks: Define intents and example utterances in nlu.yml. Train NLU model using Rasa CLI. Test intent classification using Rasa shell. Deliverable: NLU model classifying user intents accurately. Lab 5: Creating Domain and Stories for Dialogue Management Objective: Manage conversations using stories. Tasks: Define domain entities, slots, responses in domain.yml. Create stories to map intents to responses. Train dialogue management model. Test chatbot conversation flow using Rasa shell. Deliverable: Chatbot capable of multi-turn conversations. Lab 6: Developing Custom Actions and Webhook Integration Objective: Extend chatbot functionality using custom actions. Tasks: Write Python code for custom actions (actions.py). Connect custom actions via endpoints.yml. Test custom actions locally. Deliverable: Chatbot performing backend tasks (e.g., API calls). Lab 7: Deploying Rasa Chatbot as a Web Application Objective: Integrate chatbot with web interface. Tasks: Build simple HTML/JavaScript frontend to interact with Rasa chatbot. Deploy Rasa chatbot backend using Flask or FastAPI.

	Test end-to-end communication between frontend and chatbot. Deliverable: Fully deployed chatbot accessible via web browser. Lab 8: Logging and Analytics of Chatbot Interactions Objective: Monitor chatbot usage and performance. Tasks: Enable conversation trackers in Rasa. Collect logs of user interactions. Analyze logs for common queries, errors, fallback usage. Deliverable: Analytical report on chatbot performance. Lab 9: Mini Project – End-to-End Chatbot Development Objective: Apply learned skills to build a complete chatbot. Tasks: Select a use case (e.g., Helpdesk Bot, Health Assistant, Feedback Bot). Design intents, domain, and stories. Develop custom actions as needed. Train and test chatbot. Deploy chatbot locally or on cloud. Prepare project report and demo presentation. Deliverable: Functional chatbot with full documentation and live demo.
Reference Books	1) Artificial Intelligence: A Guide to Intelligent Systems, Michael Negnevitsky, Pearson Education, ISBN: 9788131708430 2) Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, O'Reilly, ISBN: 9781098125974 3) Natural Language Processing with Python, Steven Bird, Ewan Klein, O'Reilly, ISBN: 9780596516499 4) Building Chatbots with Python, Sumit Raj, Apress, ISBN: 9781484240958 5) Conversational AI: Chatbots that Work, Michael McTear, Springer, ISBN: 9783030621545 6) Machine Learning with Python, Abhishek Vijayvargia, BPB Publications, ISBN: 9789388176623 7) Deep Learning with Python, François Chollet, Manning Publications, ISBN: 9781617294433 8) Designing Bots, Amir Shevat, O'Reilly, ISBN: 9781491974827 9) Mastering Rasa, Greg Stephens, Packt Publishing, ISBN: 9781800562545 10) Streamlit for Data Science, Tyler Richards, O'Reilly (online) 11) Documentation of Rasa, https://rasa.com/docs 12) Hugging Face Tutorials, https://huggingface.co/learn
Teaching Methodology	Class Work, Discussion, Self-Study, Seminars and/or Assignments
Evaluation Method	50% Internal assessment. 50% External assessment.

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.)

[2Subject Code-511000903070002]

Course code: 407

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

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

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. 2025-2026
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 Aryabhatt.
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(vere-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 Puranapuranabhyam : "By the completion or non-completion." 4.2 Chalana-Kalana : "By motion or by applying a shift." 4.3 Yavadunam : "Whatever is the deficiency." 4.4 Vyastisamanstih : "The parts and the whole." 4.5 Sesanyan : "The remainder." 4.6 Gunitasamuchyah : "The product of the sum." 4.7 Vistaran : "Expansion." 4.8 Rupan : "Form." 4.8.1 Chidana : "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.**