श्रीशङ्कराचार्यसंस्कृतसर्वकलाशाला, कालटी

SREE SANKARACHARYA UNIVERSITY OF SANSKRIT

(A Statutory Educational Institution Constituted by Government of Kerala)

Sree Sankarapuram, P.O. Kalady, Ernakulam Dist., Kerala. PIN: 683 574

DEPARTMENT OF SANSKRIT SAHITYA

SCHEME AND SYLLABI FOR UNDER GRADUATE PROGRAMME

(BACHELOR OF ARTS IN SANSKRIT & INFORMATION TECHNOLOGY)

(CHOICE BASED CREDIT SEMESTER SYSTEM (CBCSS)

WITH

OUTCOME BASED TEACHING, LEARNING AND EVALUATION [OBTLE])

2020 ADMISSION ONWARDS

CONTENTS

OBTLE ABBREVIATIONS

CO	Course Outcome
CL	Cognitive Level
KC	Knowledge Category
R	Remember
U	Understand
Ap	Apply
An	Analyse
Ev	Evaluate
Cr	Create
F	Factual
C	Conceptual
P	Procedural

Programme Outcomes (POs)

PO1. Disciplinary knowledge: Demonstrate comprehensive knowledge and understanding of one or more disciplines that form a part of an Under Graduate Programme of study, emphasizing an awareness on traditional Indian wisdom.

PO2. Effective articulation: Comprehend complex information and texts and express thoughts and ideas effectively in writing and orally; communicate using appropriate media and present information in a lucid and concise manner to different groups; formulate coherent arguments; to plan, execute and report the results of an investigation.

PO3. Analytical reasoning: Evaluate the reliability and relevance of evidence; identify logical flaws in the arguments of others; analyse and synthesise data from a variety of sources, addressing opposing viewpoints; draw valid conclusions and support them with evidence and examples.

PO4. Research-oriented and general critical spirit of inquiry: Develop a sense of inquiry and capability to ask relevant /appropriate questions, problematise, synthesize and articulate; critically evaluate arguments, claims, beliefs, practices, policies and theories on the basis of empirical evidence; identify relevant assumptions; recognize cause-and-effect relationships, formulate hypotheses and test them, following a scientific approach to knowledge production.

PO5. Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures including one's own and develop a global perspective; effectively engage in a multicultural society and interact tolerantly and respectfully with diverse groups.

PO6. Independent, life-long learning and adaptability: Work independently with acquired knowledge and skills and to participate in self-paced learning activities throughout life aimed at personal development and for social well-being; adapt to changing trades and demands of workplace through continuous knowledge and skill development.

Programme Specific Outcomes (PSOs)

PSO 1: Acquire comprehensive knowledge in Sanskrit Language.

PSO 2: Develop the ability to read Sanskrit texts closely, focusing on generic conventions and linguistic & stylistic variations.

PSO 3: Acquire the basic language skills of a minimum of three languages including the global language; get sensitized on major contemporary social issues through representative works in these languages; critically respond and effectively articulate the same in writing and speech.

PSO 4: Conceive the general concepts of knowledge representation in Sanskrit.

PSO 5 : Recognize the logic and methods of analysis and generation of Sanskrit text using IT.

PSO 6: Understand the basic concepts of Software Development

PSO 7: Develop logical thinking for computer programming

PSO 8: Create web applications and mobile apps.

PSO 9: Apply AI concepts in NLP.

POs and PSOs tagged

No.	POs	PSOs
1	Disciplinary knowledge	Acquire comprehensive knowledge in Sanskrit Language
		Develop the ability to read Sanskrit texts closely, focusing on generic conventions and linguistic and stylistic variations.
2	Effective Articulation	Conceive the general concepts of knowledge representation in Sanskrit.
		Acquire the basic language skills of a minimum of three languages including the global language; get sensitized on major contemporary social issues through representative works in these languages; critically respond and effectively articulate the same

		in writing and speech.
3	Analytical reasoning	Recognize the logic and methods of analysis and generation of Sanskrit text using IT
		Develop logical thinking for computer programming
4	Research oriented and general critical spirit of enquiry	Create web applications and mobile apps.
5	Multicultural competence	Understand the basic concepts of Software Development
		Apply AI concepts in NLP.
6	Independent, life-long learning and adaptability	Acquire the basic language skills of a minimum of three languages including the global language; get sensitized on major contemporary social issues through representative works in these languages; critically respond and effectively articulate the same in writing and speech.
		Apply AI concepts in NLP.

Scheme and Design

General Information

Name of Programme	:	Bachelor of Arts in Sanskrit and Information Technology
Duration of the Programme	:	6 semesters
Total number of courses	:	37
Number of Common courses (A)	:	10 (6 English + 4 Adl. Language)
Number of Core courses (B)	:	14 (including Choice based Course & Project)
Number of Complimentary Courses (C)	:	8
Number of Open Courses (D)	:	1
Number of Ability Enhancement Courses /	:	4

Audit Courses (E)

Total Credits	:	136
Credits for Common Course	:	38 (22 for English + 16 for Addnl. Language)
Credits for Core Courses	:	50 (48+2 for Project)
Credits for Complimentary Course	:	28
Credits for Open Courses	:	4
Credits for Ability Enhancement Courses / Audit Courses	:	16
Minimum credits required for successful completion of the programme	:	136
Minimum credits required from English	:	22
Minimum credits required from Addl. Language	:	16
Minimum credits required from Core & Compli.	:	78
Minimum credits required from Open Course	:	4
Minimum credits required from Ability Enhancement Course/Audit Course	:	16
Total number of teaching hours / week	:	25
Total number of days / Semester	:	90

Evaluation process:

Internal assessment	:	20 Marks
External assessment	:	80 Marks

Internal assessment:

Test papers	:	10 Marks
Assignment/Seminar	:	5 Marks
Attendance	:	5 Marks

External assessment = End semester examination

Question pattern	Marks	No. of questions	Total marks
Objective type questions	1	10	10
Short answer questions	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

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Mark distribution for each Cognitive Level:

1	Remember and Understand	50%
2	Apply and Analyse	30%
3	Evaluate and Create	20%

Medium of writing examinations and Project work:

Answers for the examinations of Core and Complimentary Courses may be written in Sanskrit or in English depending upon the nature of the course. In writing in Sanskrit, Devanagari script should be used. The same may be followed in writing seminar papers / assignments and in the preparation of Project. Specific direction will be given in the detailed syllabus.

Grading System

Seven-point Scale Grading System will be used for both Internal and External assessments:

Marks	Letter Grade	Performance	Grade Point	Grade Point Range
90 and above	A+	Outstanding	10	Above 9
80 — 89.99	A	Excellent	9	Above 8 but below or equal to 9
70 — 79.99	B	Very Good	8	Above 7 but below or equal to 8
60 — 69.99	C	Good	7	Above 6 but below or equal to 7
50 — 59.99	D	Satisfactory	6	Above 5but below or equal to 6
40 — 49.99	E	Adequate	5	Above 4 but below or equal to 5

Below 40	F	Failed	4	4 or below

Semester-wise Course Details

Semester – I

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour/ Week
1	I A UENM 201	English	Common – I	4	5
2	I A UENM 202	English	Common – II	3	4
3	I A UMLM 301 I A UHNM 311 I A UURM 321 I A USGM 331	Additional Language	II Language - I	4	4
4	I B USIM 651	Methodology of Sanskrit Learning	Core - I	3	4
5	I C USIM 665	Preliminaries of Sanskrit	Complementary - I	3	4
6	I C USIM 666	Introduction to Computers	Complementary - II	3	4

Semester - II

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour/ Week
1	II A UENS 203	English	Common – III	4	5
2	II A UENS 204	English	Common – III	3	4
3	II A UMLS 302 II A UHNS 312 II A UURS 322 II A USGS 332	Additional Language	II Language - II	4	4
4	II B USIS 652	Data Structures and Algorithms	Core - II	3	4
5	II C USIS 667	Functional Sanskrit	Complementary	3	4

		Grammar	III		
6	II C USIS 668	Programming with 'C' Language	Complementary IV	3	4

Semester - III

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour/ Week
1	III A UENM 205	English	Common – V	4	5
2	III A UMLM 303	Additional Language	II Language - III	4	5
	III A UHNM313				
	III A UURM323				
	III A USGM333				
3	III B USIM653	Nyaya System of Indian Logic	Core - III	4	5
4	III C USIM669	Database Manage-ment Systems	Complementary V	4	5
5	III C USIM670	Vrtta and Alankara	Complementary V	4	5

Semester - IV

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour/ Week
1	IV A UENS 206	English	Common – VI	4	5
2	IV A UMLS304	Additional Language	II Language - IV	4	5
	IV A UHNS 314				
	IV A UURS 324				
	IV A USGS 334				
3	IV B USIS 654	Software Engineering Concepts	Core - IV	4	5
4	IV C USIS 671	Java and Web Design	Complementary -VII	4	5
5	IV C USIS 672	Linguistics	Complementary -VII	4	5

Semester – V

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour/ Week
1	V BUSIM655	Knowledge representation in Sanskrit	Core - V	3	4
2	V B USIM 656	Language Analysis in Sanskrit	Core - VI	4	5
3	V B USIM 657	Artificial Intelligence and Natural Language Processing	Core - VII	3	4
4	V B USIM 658	Programming in Python	Core - VIII	4	5
5	V B USIM 659	Project in NLP	Core - IX	2	2
6	V D USIM 673—677	Open Courses	Open Courses	4	5

Semester - VI

No.	Course Code	Title of the Course	Nature	No. of Credits	Hour / Week
1	VI B USIS 660	Sabdabodhaprakriya	Core - X	4	5
2	VI B USIS 661	Indian Theories of Meaning	Core - XI	4	5
3	VI B USIS 662	Mobile Application Development	Core - XII	4	5
4	VI B USIS 663	Advanced Natural Language Processing	Core - XIII	4	5
5	VI B USIS 664	Choice Based	Core - XIV	4	5

Ability Enhancement Courses / Audit Courses

Sem	Course Code	Title of the Courses	Credits	Hour / Week
1	I E U M 101	Environment Studies	4	0
		Disaster Management		

2	II E U S 102	Anti Narcotic / Drug Awareness	4	0
3	III E U M 103	Human Rights	4	0
		Gender Studies		
		Ethics		
4	IV E U S 104	Social Media and Cyber Ethics	4	0
		Intellectual Property Rights		
Total			16	0

SEMESTER – I

Core Course - I

Course Code : **1 B USIM 651**

Title : **Methodology of Sanskrit Learning**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course the student should be able to:

1. Understand the basics of Sanskrit Sastra texts
2. Familiar with logical thinking in Sanskrit Sastra tradition.
3. Acquire knowledge of elementary Sastra texts in Sanskrit.
4. Understand the basic concepts of Sanskrit language and grammar
5. Apply basic rules in Sastras of Sanskrit.
6. Evaluate the values in Sanskrit Sastra concepts.
7. Generate new ideas and views in Sanskrit.
8. Evaluate the relevance of Sastras of Sanskrit in the modern world.

Course Outline

Module I : Introduction in Sanskrit language - Laghupaniniyam Introduction in Sanskrit (Bhumika)

Module II : Introduction to Sanskrit Grammar - Samjnaprakarana from Laghusiddhantakaumudi

Module III : Introduction to Indian Sastra Tradition – Introduction to Indian Logic. *Tarkasangraha* – Uddesaprakarana (Saptapadarthas)

Module IV : Introduction to Mimamsa Philosophy - *Manameyodaya* Pramanakhanda - Introduction only.

Reference:

1. *Laghupaniniyam* of A.R. Rajarajavarma, Kerala University, Thiruvanathapuram,1911.
2. *Laghusiddhantakaumudi* of Varadaraja,
3. *Manameyodaya* of Narayanabhatta, Adyar Library, Adyar, Madras 20, 1933.
4. *Tarkasangraha* of Annambhatta with English Traslation, Nirnayasagara Press, Bombay, 1883.
5. *Tarkasangraha*, Malayalam Translation by Dr. T. Aryadevi, Nalanda Books, Kalady.
6. *Laghusiddhantakaumudi*, Malayalam commentary by Prof. V. Vasudevan Potti, Govt. Sanskrit College, Tripunithura.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl. No.	The Student should be able to	PO/ PSO	CL	K C	Class Hrs
CO 1	Understand the basics of Sanskrit Sastra	PO-1,	U	C	9

	texts	PSO-1			
CO 2	Familiar with logical thinking in Sanskrit Sastra tradition.	PO-3, PSO-5,7	U	C	9
CO 3	Acquire knowledge of elementary Sastra texts in Sanskrit.	PO-1, PSO-1	U	C	9
CO 4	Understand the basic concepts of Sanskrit language and grammar.	PO-1, PSO-1	U	C	9
CO 5	Apply basic rules in Sastras of Sanskrit.	PO-2, PSO-3,4	Ap	P	9
CO 6	Evaluate the values in Sanskrit Sastra concepts.	PO-4, PSO-1,2	E	C	9
CO 7	Generate new ideas and views in Sanskrit.	PO-1, PSO-1,2	C	C	9
CO8	Evaluate the relevance of Sastras of Sanskrit in the modern world	PO-6, PSO-5	E	C	9

Complementary Course – I

Course Code : **1 C USIM 665**

Title : **Preliminaries of Sanskrit**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcome : After successful completion of the course the student should be able to:

1. Understand the basics of Sanskrit language
2. Familiar with Sanskrit by listening, reading and writing.
3. Acquire knowledge of elementary texts in Sanskrit.
4. Understand the Subhasitas of Sanskrit in general.
5. Apply basic grammatical rules in Sanskrit.
6. Evaluate the ethical values in Sanskrit Subhasitas.
7. Generate new sentences in Sanskrit through translation.
8. Enjoy the reciting methods of Sanskrit verses.

Course Outline:

Module I: Sanskrit Language, The Alphabet, Vocabulary and compare with present vernaculars like Malayalam. Basic Sanskrit grammar like अक्षरमाला, अजन्तहलन्तशब्दाः, सुबन्तानि तिङन्तानि, अव्ययानि, विभक्त्यर्थाः (അതെന്ന പ്രഥമയ്ക്കർത്ഥം....) लिङ्गवचनानि, धातुलकारपुरुषाः, विशेषणविशेष्यसम्बन्धः, बाल-कवि-गुरु-पितृ-लता-नदी-श्रीशब्दानां, तच्छब्दस्य सर्वशब्दस्य च त्रिषु लिङ्गेषु रूपाणि, युष्मदस्मच्छब्दौ, एवं भूधातोः, वन्द् धातोः च दशलकारेषु रूपाणि।

Module II: Textual Study of *Sriramodanta* (1 to 30 verses) श्रीपतिं प्रणिपत्याहम् ..... इत्यारभ्य .....कौशिकस्य करे ददौ इति श्लोकपर्यन्तम्) with all traditional methods of Sanskrit studies like पदच्छेदः पदार्थोक्तिः विग्रहो वाक्ययोजना आक्षेपोऽथ समाधानम्।

Module III : Intensive Study of 15 selected Subhasitas:

1. अज्ञानतिमिरान्धस्य ज्ञानाञ्जनशलाकया।
   चक्षुरुन्मीलितं येन तस्मै स्रीगुरवे नमः।।
2. काकदृष्टिर्बकध्यानं श्वाननिद्रा तथैव च।
   अल्पाहारो जीर्णवस्त्रमेतद्विद्यार्थिलक्षणम्।।
3. यौवनं धनसम्पत्तिः प्रभुत्वमविवेकिता।
   एकैकमप्यनर्थाय किमु यत्र चतुष्टयम्।।
4. आचार्यात्पादमादत्ते पादं शिष्यः स्वमेधया।
   पादं सब्रह्मचारिभ्यः पादं कालक्रमेण च।।
5. विद्या ददाति विनयं विनयाद्याति पात्रताम्।
   पात्रत्वाद्धनमाप्नोति धनाद्धर्मं ततः सुखम्।।
6. सुलभाः पुरुषाः लोके सततं प्रियवादिनः।
   अप्रियस्य च पथ्यस्य वक्ता श्रोता च दुर्लभः।।
7. अष्टादश पुराणेषु व्यासस्य वचनद्वयम्।
   परोपकारः पुण्याय पापाय परपीडनम्।।
8. अयं निजः परो वेति गणना लघुचेतसाम्।
   उदाचरितानां तु वसुधैव कुटुम्बकम्।।
9. अल्पानामपि वस्तूनां संहतिः कार्यसाधिका।
   तृणैर्गुणत्वमापन्नैः बध्यन्ते मत्तदन्तिनः।।
10. भवन्ति नम्रास्तरवः फलागमै-
    र्नवाम्बुभिर्दूरविलम्बिनो घनाः।
    अनुद्धताः सत्पुरुषाः समृद्धिभिः
    स्वभाव एवैष परोपकारिणाम्।।

11. प्रारभ्यते न खलु विघ्नभयेन नीचैः
    प्रारभ्य विघ्नविहताः विरम्ति मध्याः।
    विघ्नैः पुनः पुनरपि प्रतिहन्यमानाः
    प्रारब्धमुत्तमजना न परित्यजन्ति।।
12. विपदि धैर्यमथाभ्युदये क्षमा
    सदसि वाक्पटुता युधि विक्रमः।
    यशसि चाभिरतिर्व्यसनं श्रुतौ
    प्रकृतिसिद्धमिदं हि महात्मनाम्।।
13. केयूराणि न भूषयन्ति पुरुषं हारा न चन्द्रोज्ज्वलाः
    न स्नानं न विलेपनं न कुसुमं नालङ्कृता मूर्धजाः।
    वाण्येका समलङ्करोति पुरुषं या संस्कृता धार्यते
    क्षीयन्ते खलु भूषणानि सततं वाग्भूषणं भूषणम्।।
14. विद्या नाम नरस्य रूपमधिकं प्रच्छन्नगुप्तं धनं
    विद्या भोगकरी यशस्सुखकरी विद्या गुरूणां गुरुः।
    विद्या बन्धुजनो विदेशगमने विद्या परा देवता
    विद्या राजसु पूज्यते न हि धनंविद्याविहीनः पशुः।,
15. पुस्तकस्था च या विद्या परहस्तगतं धनम्।
    कार्यकाले समुत्पन्ने न सा विद्या न तद्धनम्॥

Module IV : Translation and writing of Simple Sanskrit sentences.

Reference:

1. *Amarakosa* with Paramesvari Commentary, Kerala Sahitya Academi, Thrissur.
2. *Balaprabodhanam*, Anantanarayanasastrikal, Sanskrit College, Thrippunithura.
3. *Higher Sanskrit Grammar*, M.R.Kale, Motilal Banarsidass, New Delhi.
4. *Laghusamskrtam*, K.G.Poulose, VallatholVidyapeetham, Sukapuram, Edappal.
5. *Prakriyabhasyam*, Fr.JohnKunnapplly, National Book Stall, Kottayam
6. *Sabdamanjari /Dhaturupamanjari*, R.S.Vadhyar, Kalpathy, Palakkad
7. S*amskritabhasa* (3 Volumes), Kanippayur Sankaran Namputhiripad, PanchangamPublications, Kunnamkulam.
8. *Samkritadipika,* K.P.S. Sastri, Sri Ramakrishna Matham, Palai.
9. *Samskrtasvadhyaya* (5 Volumes), RashtriyaSamskritaSamsthan, New Delhi.
10. *Sriramodantam*, (ed) Prasad Anchal, Nalanda Books, Kalady

Assessment

Internal assessment 20 Marks

End semester assessment 80 Marks

Internal assessment

Class test 10

Assignment /seminar 5

Attendance 5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**

Sl. No.	The Student should be able to	PO/PSO	CL	KC	Class Hrs
CO 1	Understand the basics of Sanskrit language	PO-1, PSO-1,2	U	F	9
CO 2	Familiar with Sanskrit by Listening, reading and writing.	PO-1, PSO-1,2	U	F	9
CO 3	Acquire knowledge of elementary texts in Sanskrit.	PO-1, PSO-1,2	U	F	9
CO 4	Understand the Subhasitas of Sanskrit in general.	PO-1, PSO-1,2	U	F	9
CO 5	Apply basic grammatical rules in Sanskrit.	PO-2, PSO-1,2	Ap	C	9
CO 6	Evaluate the ethical values in Sanskrit Subhasitas.	PO-6, PSO-3	E	C	9
CO 7	Generate new sentences in Sanskrit through translation.	PO-1, PSO-1,2	C	C	9
CO8	Enjoy the reciting methods of Sanskrit verses.	PO-1,2 PSO-1,2,3	U	C	9

Complementary Course – II

Course Code : 1 C USIM 666
Title : Introduction to Computers
Number of Credits : 3
Hours per week : 4
Number of Contact Hours : 72

Course Outcomes

1. Understand the generations of computers.
2. Understand various parts of the computer.
3. Remember the operations take place inside computers.
4. Understand how the various computers are connected together to form a network.
5. Remember how to be safe in the cyber world.
6. Understand the various Operating systems.

Course Outline

Module 1 : Computer parts, generations, hardware, software. Computer languages-3GL, 4GL, 5GL. Machine language, Assembly language.

Module 2 : Input/Output devices-Keyboard, Mouse, Scanner, Printer. Storage devices. Memory- RAM, ROM, PROM, EPROM.

Module 3 : Number systems-Binary, Decimal, Hexadecimal, Octal. Relevance of Binary number system, Boolean Algebra, Computational Logic, Gates-AND, OR, NAND, NOR, NOT gates.

Module4 : Networking fundamentals: Types of networks, LAN, WAN, MAN, Cloud computing, Topologies, Bridge, Router, OSI model- Various layers.

Module 5 : Operating systems, OS as a manger of resources which include the processors, memory, data storage and I/O devices.

Reference

1. E. Balagurusamy, *Fundamentals of Computers* (2009), Tata McGraw Hill
2. Peter Norton, *Introduction To Computers* (Special Indian Edition)(2005), Tata McGraw- Hill.

3. Ms. Shikha Nutiya, - *Introduction To Computers*: All About the Hardware and Software Used In Computers, Operating Systems, Browsers, Word, Excel, Powerpoint, Emails, Printing Etc. (2013)
4. -V&S Publishers.
5. Bittu Kumar, *Computer Basics: For a Literate Living* (2017), V&S Publishers.
6. G.Manjunath B.E, *Computer Basics* (2010), Vasan Book Depot / Publications
7. Dinesh Verma, *Computer Basics and PC Software* (2012), Gullybaba Publishing House Pvt. Ltd.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**

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Sl. No.	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand the generations of computers	PO-1,5 PSO-1,2,6,9	U	F	10	0
CO 2	Understand the various parts of the computer	PO-1PSO-1,2	U	F	10	0
CO 3	Remember the operations take place inside computers	PO-1PSO-1,2	U, An	C	15	0
CO	Understand how the various	PO-1PSO-	U,	C	12	0

4	computers are connected together to form a network	1,2	An			
CO 5	Remember how to be safe in the cyber world	PO-6PSO-4,9	An, U	C	10	0
CO 6	Understand the various operating systems	PO-1,5 PSO-1,2,6,9	U	C	15	0

SEMESTER – II

Core Course - II

Course Code : **II B USIS 652**

Title : **Data Structures and Algorithms**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course the student should be able to:

1. Understand the structure of data stored inside a computer.
2. Analyze how various data structures.
3. Apply appropriate data structure as per the nature of the problem.
4. Understand how a few data structures are modified during run time.
5. Remember various algorithms used for varied needs.
6. Evaluate data structures for their optimum use.

Course Outline

Module 1 : Different types of data structures: arrays: One dimensional and multidimensional arrays. Insertion, Deletion, Search, Sort operations on arrays.

Module2 : Stack-LIFO, application of stack, queue-FIFO, applications of queue, circular queue- structure, applications.

Module 3 : Dynamic data structures, Linked list, linked list of pointers, doubly linked list, circular list, insertion and deletion of Linked list, garbage collection.

Module4 : Trees, Nodes, parent-child relationship, head, leaf node, Recursion concepts, heaps. Binary trees, Binary Search trees, B-Trees.

Module5 : Algorithms for searching and sorting: Linear search, Binary search, Quicksort, Selection sort, Insertion sort, Bubble sort, Sparse matrix.

Reference

1. Alfred V Aho, John E Hopcroft, Jeffrey D Ullman — "Data Structures and Algorithms"-2002- Pearson.
2. Alfred V Aho, John E Hopcroft, Jeffrey D Ullman-"Design and Analysis of Algorithms"-2002-Pearson.
3. G.A.V Pai-"Data Structures and Algorithms:Concepts- TEchniques and Applications.2017-McGrawHill.
4. Seymour Lipschutz-"Data Structures"-Schaum's Series.
5. R.S Salaria-"Data Structures& Algorithms using C"-Khanna Publishing.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**

Sl . No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand the structure of data stored inside a computer	PO-5 PSO-6,9	U	C	12	0

CO 2	Analyze various data structures	PO-3 PSO-5,7	An	C	12	0
CO 3	Apply appropriate data structure as per the nature of the problem	PO-3 PSO-5,7	Ap	C	12	0
CO 4	Understand how a few data structures are modified during run time	PO-3 PSO-5,7	U	C	12	0
CO 5	Remember various algorithms used for different purposes.	PO-4 PSO-8	U	C	12	0
CO 6	Evaluate data structures for their optimum use.	PO-4 PSO-8	An, U	C	12	0

Complementary Course - III

II C USIS 667

Title : **Functional Sanskrit Grammar**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Understand basic principles of Practical Sanskrit Grammar.
2. Understand basic structure and usage of Sanskrit language for writing and speaking.
3. Understand Lakaras and Lakararthas.
4. Understand Parasmaipada and Atmanepada.
5. Understand the importance of effective communication and articulation in Sanskrit.
6. Understand to prepare essays in Sanskrit on various topics.
7. Attain working knowledge in Sanskrit.

Course outline: Four Modules

Module I : Patterns of nominal declensions- types of words- varieties of nouns Five Vrttis, cases with their general and exceptional use.

Module II : Roots in Sanskrit — General introduction to Dasa Ganas - Parasmaipada and Atmanepada - Lakaras and Lakararthas.Sentence constructions - Styles of sentences in Sanskrit (Kartari- karmani-bhaveprayogah).

Module III :Sanddhi and Karaka from laghusiddhantakaumudi

Module IV : Translation of passages- from Sanskrit to English and from English to Sanskrit. Writing composition (Essay/ Poetry/ Story/ Letter) on selected forms.

Reference

- Madhusudan Misra, *Anuprayukta Samskrta Vyakaranam*, Parimal Publications, New Delhi, 1981.
- Fr. John Kunnappilly, *Prakriyabhasyam* (In Malayalam)
- Bharata Pisharoti, *Kamadhenu* (InMalayalam)
- K.G. Paulose, *Laghusamskritam* (In Malayalam), Vallathol Vidyapeetha, Edappal.
- Ananta Narayana Sastri, *Vakyatattvam* (In Malayalam), Govt. Sanskrit College, Trippunitthura.
- Maurer Watter Harding, *The Sanskrit Language*: *An Introductory Grammer and Reader*, 2 Vols, Curzon, Surrey, 1995.
- Vedprakash Sastri, *Sanskrit Parimal* (Praveshika 1&2), Neetha Publication, New Delhi, 1997.
- K.R.V. Shastri, *Sanskrit Readers* (Prathamadarsa, Dvitiyadarsa And Trtiyadarasa), R.S. Vadhyar & Sons, Palakkad, 1991.
- Acharya Digambara Mahapatra, *Saralasamskrtasambhasakam* (In Sanskrit), Prajna Prakasa, Cuttak, 2000. 26
- Vaman Shiram Apte, *The Students Guide to Sanskrit Composition*, Eastern Book Linkers, Delhi, 2004.
- Kanippayur Sankran Namputirippad, *Samskrtabhasa*, 3 Parts, Kanippayyur Sankaran Namputirippad Smaraka Granthasala, Kunnamkulam, 1997.
- Rajarshi Sri Ramavarma *Balaprabodha* — Ed. Govt Sanskrit College, Tripunithura
- *Sandhiyum Samasavum Malayalathil* by Kanippayur Sankaran Nampoothirippad

- *Lghusiddhantakaumudi*, Chakhamba Surabharati Prakashan, Varanasi, 2017.
- Prof. R.Vasudevan Potti, *Laghusiddhantakaumudi*, (Malayalam), Govt. Sanskrit College, Tripunithura.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**
			===

Sl. No.	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO1	Understand basic principles of Practical Sanskrit Grammar	PO-1, 2 PSO-2	U	C	9
CO2	Understand basic structure and usage of Sanskrit language for writing and speaking.	PO-1, PSO-2	U	C	9
CO3	Understand Lakaras and Lakararthas .	PO-1, PSO-2	U	C	9
CO4	Understand Parasmaipada and Atmanepada.	PO-1, PSO-2	U	C	8
CO5	Understand the importance of effective communication and articulation in Sanskrit.	PO-1, PSO-2,3	U	C	9

CO6	Understand the methodology to prepare essays in Sanskrit.	PO-1, PSO-2,3	U	C	10
CO7	Attain working knowledge in Sanskrit.	PO-1, PSO-1,3	U	C	9

Complementary Course – IV

Course Code : **II C USIM 668**

Title : **Programming with 'C' Language**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcome: After successful completion of the course the student should be able to:

1. Analyze a problem statement.
2. Understand various approaches of programming.
3. Remember various control statements inside a C program.
4. Create recursive programs to reduce the lines of code.
5. Create a function in a C program.
6. Understand pointers and dynamic memory allocation.
7. Analyze the time-space complexities of a C program.

Course Outline

Module1 : Concepts of Algorithms, Flowchart, Programming fundamentals-top down bottom up, modular programming, cohesion and coupling, branching, looping, Recursion, Testing and Debugging, Tools for testing and debugging.

Module2 :Basics of C language: C character set, Identifiers, Keywords, Data types, Enum type, Constants, Variables, Declarations, Qualifiers, Expressions, Symbolic constants, I/O functions, compound statements, Operators in C, Type casting, Library functions.

Module3 : Control statements, If Else, Loops, Nested If, Nested Loops, Break Continue and Goto, Arrays, Strings.

Module4 : User defined functions, Function declaration, recursion, call by value, call by reference, storage classes, automatic, external, global, static and registers.

Module 5 : Structure-declaration, use of structure variable, Union, Type def, pointers, memory allocation using pointers, Dynamic memory allocation, Freeing memory space.

Reference

1. Yashavant kanetkar, "Let us C"-bpb publications.
2. Yashavant kanetkar, "Data Structure through C"- bpb publications.
3. Brian W. Kernighan / Dennis Ritchie, "The C Programming Language"-2015-Pearson.
4. Herbert Schildt, "C: The Complete Reference"-2017-McGrawHill.
5. Pradip Dey, "Programming in C"-2011-Oxford Higher Education.
6. D.Ravichandran, "Programing in C"-1996-New Age international Publishers.
7. Mamta Bhusry, "C-Concepts & Programming" -2019-IK International Publishing house, New Delhi.
8. Subrata Saha, Subhodip Mukherjee, "Basic Computation and Programming with C"-2017-Cambridge.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**
			===

Sl No.	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Analyze a problem statement	PO-3 PSO-5,7	An	C	5	5
CO 2	Understand various approaches of programming	PO-4 PSO-8	U	C	5	5
CO 3	Remember various control statements inside a C program	PO-3 PSO-5,7	U	C	5	5
CO 4	Creative recursive programs to reduce the lines of code	PO-2,3 PSO-3,4,5,7	Un	C	5	5
CO 5	Create a function in a C program	PO-2,3 PSO-3,4,5,7	Un	C	5	5
CO 6	Understand pointers and dynamic memory allocation	PO-3 PSO-5,7	Un	C	5	5
CO 7	Analyze the time-space complexities of a C program	PO-3 PSO-5,7	An	C	6	6

SEMESTER – III

Core Course - III

Course Code : **III B USIM 653**

Title : **Nyaya System of Indian Logic**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Understand the general features of Indian Philosophy.
2. Understand the basic concepts of Indian Logic.
3. Understand the features of Nyaya philosophy.
4. Understand epistemology of Nyaya philosophy.
5. Recognize the relation of Nyaya with other knowledge systems.
6. Understand in detail the Sanskrit text Tarkasangraha.

7. Evaluate the concept of Indian Epistemology
8. Apply the methods of concept analysis in *Tarkasangraha*

Course outline

Module I General Study : भारतीयदर्शनं - सामान्यपरिचयः - आस्तिकनास्तिकदर्शनानि। ज्ञानमीसांसा भारतीयदर्शनेषु – प्रमा- प्रमाणानि

Module II General Study : न्यायदर्शनस्येतिहासः - प्रधानाचार्याः - ग्रन्थाश्च। वैशेषिकदर्शनेन सह सम्बन्धः। काणादं सर्वशास्त्रोपकारकम् । अन्नम्भट्टस्य तरर्कसङ्ग्रहः - दीपिका व्याख्या। न्यायशास्त्रप्रयोजनम्।

Module III Intensive study of *Tarkasangraha* of Annambhatta पदार्थाः, लक्षणम्, लक्षणदोषाः, द्रव्याणि, गुणाः, कर्माणि, सामान्यम्, विशेषः, समवायः, अभावः, कार्यकारणभावः, कारणभेदाः, बुद्धिभेदाः। प्रमाणानि, प्रत्यक्षम्, इन्द्रियार्थसन्निकर्षाः, अनुमानम्, उपमानम्, शब्दः, शक्तिः, लक्षणा, शब्दबोधः।

Module IV अनुमानप्रमाणस्य प्राधान्यम् । भारतीया युक्तिचिन्ता । Relevance of Indian logic in IT.

Core Reading

1. *Tarkasangraha* of Annambhatta

General Reading List

- Anantanarayana Sastri, *Tarkasara*.
- Hiriyanna, M, *An Outline of Indian Philosophy*, Motilal Banarsidass, Publishers, Delhi.
- Surendranath Dasgupta, *A History of Indian Philosophy*, VI Vols, Motilal Banarsidass Publishers P.Ltd., Delhi.
- Vasudeva Bhattathiri, C.V, *Bhartiya Darsanagal* (In Malayalam), Sahityapravartaka Sahakarana Sangham, Kottayam.
- Damodaran, K., *Bharatiyacinta* (Malayalam), Kerala Bhasha Institute, Thiruvananthapuram.
- Dr. T. Aryadevi, *Nyasastrapravesika*, Published by the Author, Trissur, 2005.
- Dr. T. Aryadevi, *Tarkasangrahadipika,* (Translation and Commentary), Kerala Sahitya Academi, Trissur, 2009.
- Muni Narayanaprasad, *Nyayadarsanam*, Narayan Gurukulam, Varkala, 2003.

- Prof. R. Vasudevan Potti, *Sastravadavali,* Sukritindra Oriental Research Institute, Tammanam, Kochi, 2004.
- Prof. V.N. Jha, *Contribution of Nyaya System to Indian Thought Structure*, Department of Sanskrit, University of Calicut, 1994.
- Prof. Mukundarajan, *Bharatiyanyayasastravum Adhunikaganitavum*, Kerala Sastra Sahitya Parishad, Kozhikode, 1990.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**

Sl. No	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO 1	Understand the general features of Indian Philosophy	PO-1, 2 PSO-2	U	C	9
CO 2	Understand the basic concepts of Indian Logic	PO-1, PSO-2	U	C	8
CO 3	Understand the features of Nyaya philosophy	PO-1, PSO-2	U	C	9
CO 4	Understand epistemology of Nyaya philosophy	PO-1, PSO-2	U	C	8
CO 5	Recognize the relation of Nyaya with	PO-1,	U	C	8

	other knowledge systems.	PSO-2			
CO 6	Understand in detail the Sanskrit text Tarkasangraha	PO-1, PSO-2	U	C	15
CO 7	Evaluate the concept of Indian Epistomology	PO-1, 3 PSO-1,3	E	C	8
CO 8	Apply the methods of concept analysis in Tarkasangraha	PO-1, 3 PSO-1,5	Ap	P	7

Complementary Course – V

Course Code : **III C USIM 669**

Title : **Database Management Systems**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes: After successful completion of the course the student should be able to:

1. Understand how data is saved for easy recovery inside a computer.
2. Remember SQL queries frequently used.
3. Apply normalization techniques to reduce redundancy and anomalies.
4. Evaluate various security measures needed for the Database.
5. Understand how to increase the performance of the queries.
6. Create queries of the categories DDL, DML and DCL.

Course Outline

Module 1 : Data models, Schemas and Instances, ER diagrams, Relational data models, Database, Table, Record, Field, Entity Integrity, Referential Integrity.

Module 2 : Structured Query Language, Data Definition Language, Data Manipulation Language, Data Control Language.

Module3 : Normalization concepts. Types of normalization-1NF, 2 NF, 3NF, 4NF, Boyce Codd NF. Data redundancy, Consistency of data, Data Integrity, Synthesis or Decomposition of Relational Database.

Module 4 :Database security-Theft and fraudulent, Loss of confidentiality or secrecy, Loss of data privacy, Loss of data integrity, Loss of

availability of data, computer-based database security-Access authorization, Access controls, Views, Backup and recovery of data, Data integrity, Encryption of data, RAID technology. Performance tuning.

Module 5 :Case study: SQL Server-Architecture, Data Storage, Buffer management, Concurrency and Locking, Data retrieval and programmability, Machine learning services, Full text search service.

Reference

1. Raghu Ramakrishnan, Johannes Gehrke-"Database Management Systems"-2014-McGrawHill.
2. Ramez Elmasri, Shamkant B Navathe-"Fundamentals of Database system"-2017-Pearson.
3. Mukesh Chandra Negi-"Fundamentals of Database Management System"-2019-bpb publications.
4. Rajiv Chopra-"Database management Systems (DBMS)"-2016- S.CHAND.
5. Dr. Jae K. Shim , Joel G. Siegel- "Database management Systems"-2002-South Western Educational publishing.
6. Abraham Silberschatz, Henry F Korth, S.Sudarshan-"Database System Concepts"-McGrawHill.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

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Sl. No.	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand how data is saved for easy recovery inside a computer.	PO-1 PSO-1,2	U	C	12	0
CO 2	Remember SQL queries frequently used	PO-6 PSO-4,9	U	C	10	2
CO 3	Apply normalization techniques to reduce redundancy and anomalies	PO-3 PSO-5,7	Ap	C	12	0
CO 4	Evaluate various security measures needed for the database	PO-2,3 PSO-3,4,5,7	An	C	12	0
CO 5	Understand how to increase the performance of the queries	PO-4 PSO-8	U	C	12	0
CO 5	Create DDL, DML and DCL	PO-2,3 PSO-3,4,5,7	Ap	C	10	2

Complementary Course – VI

Course Code : **III C USIM 670**

Title : **Vrtta and Alankara**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1) Acquire knowledge in Sanskrit meters and figures of speech.
2) Develop competence in recitation and articulation of Sanskrit verses.
3) Identify the meters and figures of speech in poetry.
4) Apply the principles of meters.
5) Understand the rules of figures of speech.

6) Understand the basic devices of poetry for better understanding and appreciation of them.
7) Recognize the logical significance of meters and figures of speech in Sanskrit.

Course outline

Module I General introduction to Vrttas — significance of Vrttas in poetic appreciation — different kinds of Vrttas—Varnikavrtta and Matravrtta—Samavrtta, Ardha- samavrtta and Visamavrtta—Chanting of Verses—Laghu and Guru - Ganas. Logical significance of Vrttas.

Module II Syllabic metres — Vasantatilaka, Vamsastha, Indravajra, Upendravajra, Upajati, Malini, Sikharini, Mandakranta, Sragdhara, Sardulavikridita, Viyogini, Puspitagra, Matra meters — Sloka, Arya and Giti.

Module III Definition of Alankara — Role of Alankaras in poetry — types of Alankaras — Sabdalankara, Arthalankara and Ubhayalankara. Upama, Rupaka, Apahnuti, Drstanta, Atisayokti, Svabhavokti, Samasokti, Arthantaranyasa, Vyatireka, Slesa.

Module IV Anuprasa, Yamaka, Citralankaras. Logical significance of Sabdalankaras.

Prescribed Texts (only relevant portions mentioned in the Modules)

1. *Kuvalayananda* of Appayya Diksita (for Arthalankaras)
2. *Candraloka* of Jayadeva (for Sabdalankaras)
3. *Laghuvrttaratnakara.*

Reference

1. Pingala's *Chandassutra*
2. *Vrttaratnavali* of 'Gomatidasa'.
3. *Vrttamanjari*
4. *Vrttaratnakara*
5. *Vrttasastram,* Mathew, Dr. T.V., State Institute of Languages, Thiruvananthapuram, 1996.
6. *Alankarasarvasva of Ruyyaka*, Chowkhamba, Varanasi, 2009.

Assessment

Internal assessment 20 Marks

End semester assessment 80 Marks

Internal assessment

Class test 10

Assignment /seminar 5

Attendance 5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

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Sl. No.	The Student should able to	PO/PSO	CL	KC	Class Hrs
CO 1	Acquire knowledge in Sanskrit meters and figures of speech.	PO-1, 2 PSO-1,2	U	C	12
CO 2	Develop competence in recitation and articulation of Sanskrit verses.	PO-1, 2 PSO-2	Ap	P	7
CO 3	Identify the meters and figures of speech in poetry.	PO-1, PSO-2,3	U	C	7
CO 4	Apply the principles of meters.	PO-1,22 PSO-2,3	Ap	P	8
CO 5	Understand the rules of figures of speech.	PO-1, 2 PSO-2,3	U	C	12
CO 6	Understand the basic devices of poetry for better understanding and appreciation of them.	PO-1, 2 PSO-2,3	U	C	11
CO 7	Recognize the logical significance of meters and figures of speech in Sanskrit.	PO-1, 3 PSO-1,5	U	C	8

SEMESTER – IV

Core Course - IV

Course Code : IV B USIS654

Title : Software Engineering Concepts

Number of Credits : 4

Hours per week : 5

Number of Contact Hours : 72

Course Outcome: After successful completion of the course the student should be able to:

1. Understand the organizational structure and the role of information system in an organization.
2. Apply suitable method for designing a software.
3. Remember various design practices recommended by IEEE.
4. Understand Software Development Life Cycle.
5. Understand Capability Maturity Model and various levels of it.
6. Analyze various testing methods and tools.
7. Create a quality product.

Course Outline

Module1: Information system concepts, business organization-organizational chart, information system levels-operational, lower, middle, top management, SDLC concepts, Lifecycle activities, role of system analyst, life cycle flowchart.

Module2: Forms design (input design), Output design, Database design, Process design. Tools for design-decision charts, decision tables, decision trees, structured English, DFD, data dictionary, system flow charts, HIPO charts.

Module3: Development phase activities. Bottom up and top down computer program development. User trainings, PERT, structured programming, Development phase report.

Module 4: Software Engineering concepts, SDLC models, Process management, SPI, Requirements Engineering, Cost estimation, COCOMO model.

Module 5: Software Design, IEEE recommended practice for software design,CMM levels, Software testing, test cases, tools, Verification

and Validation. Types of testing: Alpha testing, Beta testing, Unit testing, Integration testing, System testing.

Reference

1. Roger S Pressman-"Software Engineering- A Practitioner's approach"-2009-McGrawHill
2. Roger S Pressman, Bruce R Maxim-"Software Engineering- A Practitioner's approach"-2019-McGrawHill
3. Rajib Mall-"Fundamentals of Software engineering"-2018-PHI.
4. Joan Peckhqm-"Practising Software Engineering in the 21st Century"-2003-IRM Press.
5. Ian Sommerville-"Software Engineering"-1982-Pearson Education.
6. Rod Stephens-"Beginning Software Engineering"-2015-Wrox, Wiley.
7. Pankaj Jalote —"An Integrated Approach to Software Engineering"-1991-Springer.
8. Ali Behforooz-" Software Engineering Fundamentals"-1996-Oxford

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab

CO 1	Understand the organizational structure and the role of information system in an organization.	PO-1,2 PSO-1,2,3,4	U	F	12	0
CO 2	Apply suitable method for designing a software	PO-3 PSO-5,7	Ap	C	12	0
CO 3	Remember various design practices recommended by IEEE	PO-1,3 PSO-1,2,5,7	U	C	12	0
CO 4	Understand Software Development Life Cycle	PO-3 PSO-5,7	U	C	12	0
CO 5	Understand Capability Maturity Model and its various levels	PO-6 PSO-4,9	U	C	12	0
CO 6	Analyze various testing methods and tools	PO-3 PSO-5,7	An	C	6	0
CO 7	Create a quality product	PO-2,3 PSO 3,4,5,7	U	C	6	0

Complementary Course - VII

Course Code : **IV C USIS671**
Title : **Java and Web Design**
Number of Credits : **4**
Hours per week : **5**
Number of Contact Hours : **72**

Course Outcome: After successful completion of the course the student should be able to:

1. Understand classes in Java.
2. Create JAVA code.
3. Remember control statements in Java.
4. Create arrays in their JAVA code.
5. Create Scripts using Javascript and VB Script.
6. Understand applet and its lifecycle.

7. Create HTML page.
8. Understand Cyber security.

Course Outline

Module1: Introduction to Java: History of Java, Features of Java, Java Development Kit (JDK), Security in Java. Java Basics: Keywords; Working of Java; Including Comments; Data Types in Java; Primitive Data Types; Abstract / Derived Data Types; Variables in Java; Using Classes in Java; Declaring Methods in Java, Code to Display Test Value; The main() Method, Invoking a Method in Java; Saving, Compiling and Executing Java Programs.

Module 2: Operators and Control Statements: Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators, Logical Operators, Operator Precedence; Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do…While Loop, Break Statement Continue Statement. Arrays and Strings: Arrays; String Handling; Special String Operations; Character Extraction; String Comparison; Searching Strings; String Modification; StringBuffer.

Module 3: Inheritance, Package and Interface: Inheritance, Types of Relationships, What is Inheritance?, Significance of Generalization, Inheritance in Java, Access Specifiers, The Abstract Class; Packages, Defining a Package, CLASSPATH; Interface, Defining an Interface, Some Uses of Interfaces, Interfaces versus Abstract Classes. Exception Handling: Definition of an Exception; Exception Classes; Common Exceptions; Exception Handling Techniques. Streams in Java: Streams Basics; Abstract Streams; Stream Classes; Readers and Writers; Random Access Files; Serialization.

Module 4: Applets: What are Applets?; The Applet Class; The Applet and HTML; Life Cycle of an Applet; The Graphics Class; Painting the Applet; User Interfaces for Applet; Adding Components to user interface; AWT (Abstract Windowing Toolkit) Controls. Event Handling: Components of an Event; Event Classes; Event Listener; Event-Handling; Adapter Classes; Inner Classes; Anonymous Classes.

Swing: Concepts of Swing; Java Foundation Class (JFC); Swing Packages and Classes; Working with Swing- An Example; Swing Components

Module 5: HTML programming, VB Script, Javascript, ASP, Frontpage, Internet security. Ecommerce, web publishing and browsing, Client server technology, cloud computing.

Reference

1. Herbert Schildt, *The Complete Reference- Java2*, 1996-Tata McGraw Hill.
2. Herbert Schildt, *Java-A beginner's Guide*, 2002, Oracle Press.
3. Kathy Sierra, Bert Bates, *HEad first JAVA*- 2003, O'REILLY.
4. Bruce Eckel, *Thinking in JAVA*, 1998, Prentice Hall
5. Joshua Bloch, *Effective JAVA*, 2001, Addison-Wesley Professional
6. Cay S. Horstmann, *Core JAVA*, 1996, Prentice Hall.
7. David Flanagan, *Student Workbook Java in a Nutshell,* 1996, O'Reilly & Associate.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl.	The student should be able	PO/PSO	CL	KC	Sessions/Hrs

No	to				Class	Lab
CO 1	Understand classes in Java	PO-2,3 PSO-3,4,5,7	U	C	12	0
CO 2	Create JAVA code	PO-3 PSO-5,7	U,Ap	C	12	4
CO 3	Remember control statements in Java	PO1,2 PSO-1,2,3,4	U	C	6	6
CO 4	Create arrays in their JAVA code	PO-2,3 PSO-3,4,5,7	U, Ap	C	4	4
CO 5	Create scripts using Javascript and VBscript	PO-2,3 PSO-3,4,5,7	U,Ap	C	4	4
CO 6	Understand applet and its lifecycle	PO-3 PSO-5,7	U	C	6	0
CO 7	Create HTML page	PO-3 PSO-5,7	U, Ap	C	4	2
CO 8	Understand Cyber security	PO-6 PSO-4,9	U	C	4	0

Complementary Course - VIII

Course Code : **IV C USIS 672**

Title : **Linguistics**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

CO1 Understand the preliminaries of general linguistics.

CO2 Understand the history of Sanskrit language and its relation with other languages.

CO3 Understand the concepts of linguistics.

CO4 Analyse the basis of Sanskrit language and Indian grammatical tradition.

CO5 Compare Paniniyan linguistics with the modern linguistics.

CO6 Apply the Traditional knowledge in new language situations.

CO7 Understand the Computational aspects of Sanskrit language, linguistics and etymology.

Course Outline

Module I : Introduction, Nature and Scope of the Science of language - Four divisions - Phonology, Morphology, Semantics and Syntax. General survey of linguistics - linguistic families - Indo Eurpean families.

Module II : Phonetics - Organs of Speech - Phonetic change, Phonetic laws - Fortunators Law - Grassman's Law of deaspiration - Grimm's Law, The Law of Palatalisation. Classification and importance of Analogy.

Module III : Morphology- definition - main branches (nominal, pronominal, numeral and verbal morphology), number, genders, case forms, sufixes and prefixes, morpheme morphological classification. Isolating or monosyllabic or radical - agglutinating and inflexional - organic and inorganic language - morpheme word formation - Krtanta and Tinganta pratyayas.

Module IV: Semantics - primary and secondary meaning - Semantic change - Causes of Semantic change. Syntax. Set of rules, principles, and processes that govern the structure of sentences in language, especially in Sanskrit. Computational aspects of Sanskrit linguistics.

Reference

- *An introduction to Sanskrit Linguistics*, Sreemannarayana Murthi.
- *Comparative Philology of Indo European Languages*, T.K. Ramachandra Iyer R.S. Vadhyar & Sons, Kalpathi, Palakkad.
- *General Linguistics* - An introductory Survey, Robins R.H.
- *Linguistics Introduction to Sanskrit*, Balakrishna Ghosh.
- *A History of Sanskrit Literature*, A.B. Keith, Motilal Banarsidass Publishers, Delhi, 1993.
- *History of Classical Sanskrit Literature*, Krishnamachariar
- *A Short History of Sanskrit Literature*. Prof. T.K. Ramachandra Iyer, R.S. Vadhyar & Sons, Kalpathi, Palakkad.
- *Samskritasahityetihasah*— Acharya Lokamani Dahala, Krishnadas Academy, Varanasi, 1993.
- *Samskritasahityacaritram,* Kerala Sahitya Academy, Trissur, 2002.

- *Sanskrit Computational Linguistics*, Peter Scharf: Gerard Huet: Amba Kulkarni, Springer Customer Service Center GmbH; 2 edition (2009).
- *Phonetics in Ancient India*, W S Allen, 1971
- *Sanskrit Philosophy of Language*, JF Stall, 1969.
- *Indian theories of Meaning*, Raja K. Kunjuni, 1963.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl. No.	The Student should be able to	PO/PSO	CL	KC	Class Hrs
CO1	Understand the preliminaries of general linguistics.	PO-1, 2 PSO-2	U	F	9
CO2	Understand the history of Sanskrit language and its relation with other languages.	PO-1, 2 PSO-2	U	F	9
CO3	Understand the concepts of linguistics.	PO-1, PSO-2	U	C	8
CO4	Analyse the basis of Sanskrit language and Indian grammatical tradition.	PO-1, 3 PSO-2,5	A	P	9
CO5	Compare Paniniyan linguistics with the modern linguistics.	PO-1, 4 PSO-2	A	P	8

CO6	Apply the Traditional knowledge in new language situations.	PO-1, 4 PSO-2,5	Ap	C	8
CO7	Understand the Computational aspects of Sanskrit language, linguistics and etymology.	PO-1, 4 PSO-2,5	U	C	15

SEMESTER – V

Core Course - V

Course Code : **V B USIM 655**

Title : **Knowledge Representation in Sanskrit**

Number of Credits : **3**

Hours per week : **4**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember the linguistic aspects of Sanskrit Grammar
2. Recognize the concepts of Vyaakarana with reference to computational linguistics.
3. Understand the functional aspects of language.
4. Develop skills in using Sanskrit language.
5. Understand the elements of grammar like noun, verb, pronoun, tense and moods.
6. Understand in detail the formation of Subantas and Tinnantas in Sanskrit.
7. Analyze Sanskrit sentences.

Course outline

Module I: Phonology; Phonemics; Sandhi rules in *Astadhyayi* - Pada formation – Subanta, Tinganta, Krt, Taddhita; inflectional and derivational morphology, various approaches of morphological analysis - Syntactic Analysis, Karaka relations, - Akanksa, Yogyta and Sannidhi. Compounds in Sanskrit.

Module II: Word forming suffixes - सुप् प्रत्ययाः - रामशब्दस्य सर्वेषां रूपाणां रूपसिद्धिः - सूत्रसहितं प्रक्रियानिर्णयः।

Module III: Verb forming suffixes - तिङ् प्रत्ययाः - भूधातोः एधधातोः च सर्वलकाराणां रूपसिद्धिः। उपसर्गाः।

Module IV: Vyakarana and Natural Language Processing - the parallel Linguistic terminology and concepts — Sanskrit Grammar and computational linguistics.

Essential Reading:

Laghusiddhantakaumudi of Varadaraja

Reference

- *Vaiyyakaranasiddhantakaumudi* of Bhattoji Diksita.
- *NLP: A Paninian Perspective by Akshar Bharati*, Vineet Chaitanya, Sangal, Prentice Hall of India, 1995.
- *Speech and Language Processing* By Daniel Jurafsky and James H Martin.
- *Computational Linguistics*,
- *Sanskrit Computational Liguistics*
- *A Key to Karaka*
- *An introduction to Sanskrit Linguistics*, Sreemannarayana Murthi.
- Sanskrit Computational Linguistics,Peter Scharf:Gerard Huet: Amba Kulkarni, Springer Customer Service Center GmbH; 2 edition (2009).
- *Phonetics in Ancient India*, W S Allen, 1971
- Annotation guidelines developed by Sanskrit Consortium
- Relevant research papers in the field of Machine Translation, Natural Language Processing,

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16

Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**
			===

Sl. No	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO 1	Remember the linguistic aspects of Sanskrit Grammar	PO-1, 2 PSO-1,2	R	C	9
CO 2	Recognize the concepts of Vyaakarana with reference to computational linguistics.	PO-1, PSO-1,2	U	C	8
CO 3	Understand the functional aspects of language.	PO-1, 2 PSO-1,2,3	U	C	9
CO 4	Develop skills in using Sanskrit language.	PO-1, 2 PSO-1,2,3	C	P	8
CO 5	Understand the elements of grammar like noun, verb, pronoun, tense and moods.	PO-1, 2 PSO-2, 3	U	C	8
CO 6	Understand in detail the formation of Subantas and Tinnantas in Sanskrit.	PO-1, 2 PSO-1,2	U	C	15
CO 7	Analyze Sanskrit sentences.	PO-1, 3 PSO-1,3,5	An	P	8

Core Course - VI

Course Code : **V B USIM 656**

Title : **Language Analysis in Sanskrit**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember the general features of Indian Philosophy
2. Understand the basic concepts of Indian system of sentence analysis.
3. Understand the origin and development of Mimamsa philosophy.
4. Recognize the features of Mimamsa philosophy.
5. Recognize the relation of Mimamsa with other knowledge systems.
6. Understand in detail the Sanskrit text Arthasangraha.
7. Evaluate the concept of Indian textual analysis.
8. Apply the methods of sentence analysis of Mimamsa philosophy.

Course outline

Module I: General Study : पदवाक्यप्रमाणज्ञानस्य प्राधान्यं भारतीयपरम्परायाम्। वाक्यविचारः भारतीयदर्शनेषु व्याकरणशास्त्रे च — पूर्वमीमांसादर्शनस्य आगम्भः विकासश्च । मीसांसाशास्त्रप्रयोजनम् । पूर्वमीमांसायाः आचार्याः तेषां रचनाः च। लौगाक्षिभास्करस्य अर्थसङ्ग्रहः ।

Module II: मीसांसादर्शनस्य मुख्यतत्वानि ।वेदप्रामाण्यं, धर्मः, कर्मप्राधान्यं, भावना, अपूर्वम्, विधिः, मन्त्रः. देवता, अर्थवादः, अङ्गप्रधानभावाः ।Purvamimamsa Techniques of Programme organisation - Theories of Sentence meaning.

Module III: Intensive study of *Arthasangraha* of Laugaksibhaskara.

Module IV: Relevance of sentence analysis of Mimamsa in contemporary scenario. Mimamsa and Indian Jurisprudence. System of sentence analysis of Mimamsa and computational linguistics.

Core Reading

Arthasangraha of Laukaksibhaskara.

General Reading List

- Hiriyanna, M, *An Outline of Indian Philosophy*, Motilal Banarsidass, Publishers, Delhi.
- Surendranath Dasgupta, *A History of Indian Philosophy*, VI Vols, Motilal Banarsidass Publishers P.Ltd., Delhi.
- Vasudeva Bhattathiri, C.V. *Bhartiya Darsanagal* (In Malayalam), Sahityapravartaka Sahakarana Sangham, Kottayam.
- Damodaran, K., *Bharatiyacinta* (Malayalam), Kerala Bhasha Institute, Thiruvananthapuram.
- Dr.S.RAdhakrishnan, *Indian PHilosophy,*

- Dr. T. Aryadevi, *Arthasangraha,* Nalanda Books, Kalady, 2013.
- Prof. R. Vasudevan Potti, *Sastravadavali,* Sukritindra Oriental Research Institute, Tammanam, Kochi, 2004.
- Brough, J., *Theories of General Linguistics in Sanskrit*, Transactions of the Philological Society, London, 1951.
- Devasthali G.V., *Mimamsa the Ancient Indian Science of Sentence Interpretation*, Sri Sadgum publications, II Edition by V.N. Jha, New Delhi.
- Gachter Othmar, *Hermenutics and Language in Purvamimamsa - A Study in Sabarabhasya*, Motilal Banarsidas, Delhi,IstEd. 1983,1990.
- Keith A.B., *Karma mimamsa*. Oriental Books, New Delhi, lied. 1978.
- Raja K. Kunjunni, *Mimamsa contribution to Language Studies*, Department of Sanskrit, University of Calicut, 1988.
- Sarma Rajendranath, *Mimamsa theory of meaning (based on vakyartha matrka*), Sri Sadguru Publications, Delhi, 1988.
- Raja K. Kunjunni, *Indian Theories of Meaning*.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**
			===

Sl. No	The student should be able to	PO/PSO	CL	KC	Class

					Hrs
CO 1	Remember the general features of Indian Philosophy	PO-1, 2 PSO-2	R	F	7
CO 2	Understand the basic concepts of Indian system of sentence analysis.	PO-1, 3 PSO-2,5	U	C	8
CO 3	Understand the origin and development of Mimamsa philosophy.	PO-1, PSO-2,4	U	F	9
CO 4	Recognize the features of Mimamsa philosophy.	PO-1, 3 PSO-2,5	U	F	7
CO 5	Recognize the relation of Mimamsa with other knowledge systems.	PO-1, PSO-2,4	U	C	7
CO 6	Understand in detail the Sanskrit text Arthasangraha.	PO-1, PSO-2,4	U	C	19
CO 7	Evaluate the concept of Indian textual analysis.	PO-1, 3 PSO-1,3,4,5	E	C	8

Core Course – VII

Course Code : V B USIM 657

Title : Artificial Intelligence and Natural Language Processing

Number of Credits : 3

Hours per week : 4

Number of Contact Hours : 72

Course Outcomes: After successful completion of the course the student should be able to:

1. Understand how Intelligence can be created artificially.
2. Understand what is meant by knowledge base.
3. Analyze various problems in AI.
4. Apply predicate calculus for representing information.
5. Understand how machine learning can be useful in increasing the intelligence of the system.
6. Remember how commonsense can be used in reasoning.
7. Understand computational linguistics.

8. Analyze text using computational models.
9. Understand various steps in NLP.

Course Outline

Module1: Fundamentals of AI: problems, theories and algorithms of AI, problem solving, reasoning, planning, natural language understanding, computer vision, automatic programming, machine learning.

Module 2: Heuristic search, Knowledge representation using predicate calculus, Representing Simple Facts in Logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution, Natural Deduction.

Module3: Automated deduction and its applications. Planning. Machine Learning: game playing, uncertain reasoning, expert systems, NLP systems, Logic for commonsense reasoning, ontologies, multi agent systems.

Module 4: NLP: Introduction to Computational Linguistics, Computational modeling of human language, the ongoing efforts to create computer programs communicating with people in NL. Current application of the NL field, automated document classification, intelligent query processing and information extraction.

Module 5: Steps in NLP: Lexical Analysis, Syntax Analysis, Semantics Analysis, Discourse Integration, Pragmatic Analysis, POS tagging.

Reference

1. Tom Taulli – "Artificial Intelligence Basics: A Non-Technical Introduction"-2019- APRESS.
2. Nick Bostrom– "Superintelligence: Paths, Dangers, Strategies"-2016-Oxford University press.
3. Melanie Mitchell – "Artificial Intelligence: A Guide for Thinking Humans Hardcover"– 2019-Pelican.
4. Ray Kurzweil- "How to Create a Mind: The Secret of Human Thought Revealed"-2013-Penguin Books.
5. Pedro Domingos- "The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World"-2015-Basic books.

6. Steven Bird, Ewan Klein, Edward Loper- "Natural Language Processing with Python"-2009-O'reilly.
7. Dan Jurafsky and James H. Martin- "Speech and Language Processing"-2008-Pearson.
8. Richard Bandler, Alessio Roberti, Owen Fitzpatrick-" The Ultimate Introduction to NLP: How to build a successful life "-2013-Harper Collins.
9. Li Deng, Yang Liu-"Deep Learning in Natural Language Processing"-2018-Springer.
10. Yoav Goldberg- "Neural Network Methods in Natural Language Processing"-2017-Morgan & Claypool.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

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Sl. No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand how intelligence can be created artificially	PO 1,2,3,5 PSO1,2, 3,4,5,6,7,9	U	C	8	0
CO 2	Understand what is meant by knowledge base	PO-2,3,5,6 PSO-	U	C	8	0

		3,4,5,7,4,6,9				
CO 3	Analyze various problems in AI	PO-3 PSO-5,7	An	C	8	0
CO 4	Apply predicate calculus for representing information	PO-2,3 PSO-3,4,5,7	Ap	C	6	0
CO 5	Understand how machine learning can be used to increase the performance of the system.	PO-3,5 PSO-5,7,6,9	U	C	6	0
CO 6	Remember how commonsense can be used in reasoning	PO-3,5 PSO-5,7,6,9	U	C	6	0
CO 7	Understand computational linguistics	PO-3,5,6 PSO - 5,7,6,9,4	U	C	10	0
CO 8	Analyze text using computational models	PO-3,5 PSO-5,7,6,9	An	C	10	0
CO 9	Understand various steps in NLP	PO-1,3,5 PSO-1,2,5,7,6,9	U	C	10	0

Core Course – VIII

Course Code : **V B USIM 658**

Title : **Programming in Python**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes: After successful completion of the course the student should be able to:

1. Understand a problem logically.
2. Analyze a problem to be solved.
3. Create executable code.
4. Understand most Python code.
5. Create basic unit tests.
6. Understand the programming in open source platform.

Course Outline

Module1: General Introduction to Python and the class. Using the command interpreter and development environment, Kick-off tutorial, Finding and using the documentation, Getting help, Python 2/3 differences.

Module 2: Introduction to git and GitHub, Basic data types, Functions: definition and use, arguments, block structure, scope, recursion, Modules and import, Conditionals and Boolean expressions.

Module 3: Sequences: Strings, Tuples, Lists. Iteration, looping and control flow. String methods and formatting. Dictionaries, Sets and Mutability. Files and Text Processing. Exceptions. Testing.List and Dict Comprehensions.

Module4: Advanced Argument passing, Lambda, Functions as Objects, Classes,Class instances, Methods, Multiple inheritance, Properties, Special methods, Emulating built-in types.

Module5: Iterators and Generators, Decorators, Context Managers, Regular expression, Wrap Up / Students Code review.

Reference

1. Martin. C. Brown, *Python- The complete reference*, 2018, McGraw Hill.
2. R. Nageshwara Rao, *Core Python Programming*, 2018, Dreamtech.
3. Ashok Namdev Kamthane, Amit Ashok Kamthane, *Python Programming,* McGrawHill.
4. Eric Matthes, *Python Crash Course*, 2nd Edition: *A Hands-On, Project-Based Introduction to Programming*, 2015, No Starch Press.
5. Mark Summerfield, *Programming in Python* 3, 2018, Addison-Wesley Professional.
6. Ashok Namdev Kamthane and Amit Ashok Kamthane, *Programming and Problem Solving with Python*, 2017, McGrawHill.
7. Taneja Sheetal (Author), Kumar Naveen (Author), *Python Programming: A Modular Approach*, 2017-Pearson.
8. Liang Y. Daniel, *Introduction to Programming Using Python*, 2017, Pearson.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl. No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand a problem logically	PO-1,3 PSo-1,2,5,7	U	C	6	6
CO 2	Analyze a problem to be solved	PO-3 PSO-5,7	An	C	6	6
CO 3	Create executable code	PO-2 PSO-3,4	U, Ap	C	6	6
CO 4	Understand Python code	PO-3 PSO-5,7	U	C	6	6
CO 5	Create basic unit tests	PO-2,3 PSO-3,4,5,7	Ap	C	6	6
CO 6	Understand the programming in open source platform	PO-3,5,6 PSO-5,7,4,6,9	U	C	6	6

Core Course – IX

Course Code : V B USIM 659

Title : Project in NLP

Number of Credits : 2

Hours per week : 2

Number of Contact Hours : 32

Course Outcome: After successful completion of the course the student should be able to:

1. Understand the ways of looking at a specific problem.
2. Analyze the problem.
3. Apply the concepts of software development to solve the problem.
4. Develop code in programming languages to solve the problem in NLP.
5. Create test cases.
6. Evaluate the code.

Evaluation

Internal-2 credits altogether for test paper, assignment and attendance.

External- 2 credits for end semester examination

Sl.No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand the ways of looking at a specific problem	PO-1,3 PSO-1,2,5,7	U	C	4	0
CO 2	Analyze the problem	PO-3 PSO-5,7	U	C	4	0
CO 3	Apply the concept of software development to solve the problem	PO-3 PSO-5,7	Ap	C	2	14
CO 4	Develop code in programming languages	PO-2,3 PSO-3,4,5,7	Ap	C	2	14
CO 5	Create test cases	PO-2,3 PSO-3,4,5,7	Ap	C	2	12
CO 6	Evaluate the code	PO-2,3,6 PSO-3,4,5,7,4,9	Ap	C	2	16

SEMESTER – VI

Core Course - X

Course Code	:	**VI B USIS 660**
Title	:	**Sabdabodhaprakriya**
Number of Credits	:	**4**
Hours per week	:	**5**
Number of Contact Hours	:	**72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember the linguistic features of Indian Philosophy.
2. Remember the basic concepts of Indian Logic.
4. Remember the features and epistemology of Nyaya philosophy.
5. Understand the concept of verbal cognition in Indian philosophy.
6. Recognize theprocess of verbal cognition in Nyaya and other knowledge systems.
7. Understand in detail the Sabdakhanda of Nyasasiddhantamuktavali.
8. Evaluate the concept and process of verbal cognition inNyaya philosophy.
9. Correlate the verbal cognition of Nyaya to the concepts of computational linguistics.

Course outline

Module I: General study : Epistemology in Indian Philosophy – the authority of Verbal cognition – Verbal cognition in Nyaya and other systems.

Module II : The methods of language acquisition (Sabdabodhaprakaras). Padajnana, Padarthajnana and Vakyarthajnana. Akanksa, Yogyata, Sannidhi and Tatparya. Abhidha, Laksana and Vyanjana.

ModuleIII: Detailed Study of Sabdakhandaof *Nyayasiddhantamuktavali* of Visvanathapancanana.

Module IV : Navyanyaya methodology as a tool of language study. The syntactical relation ofthe Nyaya method of language comprehension.

Core Reading:

Nyayasiddhantamuktavali of Visvanathapancanana.

General Reading List

- Anantanarayana Sastri, *Tarkasara.*

- Hiriyanna, M, *An Outline of Indian Philosophy*, Motilal Banarsidass, Publishers, Delhi.
- Surendranath Dasgupta, *A History of Indian Philosophy*, VI Vols, Motilal Banarsidass Publishers P.Ltd., Delhi.
- Vasudeva Bhattathiri, C.V. *Bhartiya Darsanagal* (In Malayalam), Sahityapravartaka Sahakarana Sangham, Kottayam.
- Damodaran, K., *Bharatiyacinta* (Malayalam), Kerala Bhasha Institute, Thiruvananthapuram.
- Dr. T. Aryadevi, *Nyasastrapravesika*, Published by the Author, Trissur, 2005.
- Dr. T. Aryadevi, *Tarkasangrahadipika,* (Translation and Commentary), Kerala Sahitya Academi, Trissur, 2009.
- Muni Narayanaprasad, *Nyayadarsanam*, Narayan Gurukulam, Varkala, 2003.
- Prof. R. Vasudevan Potti, *Sastravadavali,* Sukritindra Oriental Research Institute, Tammanam, Kochi, 2004.
- Prof. V.N.Jha, *Contribution of Nyaya System to Indian Thought Structure*, Department of Sanskrit, University of Calicut, 1994.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**
			===

Sl. No	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO 1	Remember the linguistic features of Indian Philosophy.	PO-1, 2 PSO-2,4	U	F	8
CO 2	Remember the basic concepts of Indian Logic.	PO-1, PSO-2,5	U	C	8
CO 3	Remember the features and epistemology of Nyaya philosophy.	PO-1, PSO-2,5	U	F	7
CO 4	Understand the concept of verbal cognition in Indian philosophy.	PO-1, PSO-2	U	C	8
CO 5	Recognize the process of verbal cognition in Nyaya and other knowledge systems.	PO-1, PSO-2,5	U	C	8
CO 6	Understand in detail the Sabdakhanda of Nyasasiddhantamuktavali.	PO-1, 3 PSO-2,4,5	U	C	19
CO 7	Evaluate the concept and process of verbal cognition in Nyaya philosophy.	PO-1, 3 PSO-1,3	E	C	8
CO 8	Correlate the verbal cognition of Nyaya to the concepts of computational linguistics.	PO-1, 3 PSO-1,3	E	C	8

Core Course - XI

Course Code : **VI B USIS 661**

Title : **Indian Theories of Meaning**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember the basic concept of Language comprehension in Indian traditions.
2. Understand the basic concept of Meaning in Indian traditions.
3. Understand the concept of Sadba and Artha in Alankarasastra.

4. Understand in Detail the concepts of Abhidha, Laksana and Vyanjana.
5. Analyze the different approaches to the study of meaning.
6. Understand the contribution of Mammata to Language Studies.
7. Understand the Traditional discussions of Poeticians on meaning.

Course outline

Module I : Introduction – the basic concept of Sabda in Indian traditions Vyakarana, Sahitya and Indian philosophical systems.

Module II : The basic concepts of meaning in Indian traditions-the meaning of meaning-the problem of meaning –different approaches to the study of meaning- conditions of knowing the meaning of a sentence – Akamksha, Yogyata, Sannidhi, Tatparyajnana.

Module III: Poetic texts on Sabdavyaparas, Introduction to Mammata and Kavyaprakasa.

Module IV: Intensive study of Kavyaprakasa II Ullasa.

Required Reading:

Kavyaprakasa of Mammata

Reference:

1. *Indian Theories of Meaning*, K. Kunjunni Raja, The Adayar Library and Research Centre, 1997.
2. Essays in Sanskrit Criticism, K. Krishnamurthi, Karnatak University, Dharwar, 1997.
3. *Sabdatatvavimarsa*, Sreyams Dvivedi, Abhisheka Prakasan, Delhi, 2006.
4. *Arthavijnanam,* Vedabandhu, Kerala Bhasha Institute, Thiruvananthauram, 1988.
5. *History of Sanskrit Poetics*, P.V. Kane, Motilal Banarsidass, Delhi, 1987.
6. *History of Sanskrit Poetics*, S.K. De, Firma, Klm Pvt Limited, Calcutta, 1988.
7. *Indian Aesthetics*- K.C. Pande
8. *History of Sanskrit Literature*- S.K. De and S.N. Das Gupta
9. *Studies in Indian Aesthetics and Criticism* – K.Krishnamoorthy
10. *Alankarasastrasyetihasah* – Dr. Jagadisha Chandra Mishra.
11. *Kavyaprakasa* of Mammata with Balabodhini of Jhalakikara, BORI, Poona,
12. *Kavyaprakasa* with Pradipa and Udyota commentaries,

13. *Kavyaprakasa* of Mammata with English tran. Ganganatha Jha, Varanasi.
14. *Sabdarthasiddhantangal Samskrtattil,* Dr. N.V.P. Unithiri, Kerala Bhasha Institute, Thiruvananthapuram, 2009.
15. *Artham-Bharatheeyasiddhantangal,* (Malayalam trans. of *Indian Theories of Meaning*), K.A. Ravindran, Vallathol Vidyapeetham, Sukapuram, Edappal, 2018.

Note: As far as possible Sanskrit language should be used as the medium of instruction. Students are to be motivated and trained to use Sanskrit in the traditional way of interpretations of Sanskrit texts.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**

Sl.No	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO1	Rememebr the basic concept of Language comprehension in Indian traditions.	PO-1, 2 PSO-2,4	U	C	7
CO2	Understand the basic concept of Meaning in Indian traditions.	PO-1,2 PSO-2,4	U	C	8
CO3	Understand the concept of Sadba and	PO-1, 2	U	C	8

	Artha in Alankarasastra.	PSO-2,4			
CO4	Understand in Detail the concepts of Abhidha, Laksana and Vyanjana.	PO-1, 2 PSO-2,4	U	C	12
CO5	Analyze the different approaches to the study of meaning.	PO-1, PSO-2	An	P	8
CO6	Understand the contribution of Mammata to Language Studies.	PO-1, PSO-1,2	U	F	15
CO7	Understand the Traditional discussions of Poeticians on meaning.	PO-1, 2 PSO-1,2,3	U	C	8

Core Course - XII

Course Code : **VI B USIS 662**

Title : **Mobile Application Development**

Number of Credits : **4**

Hours per week : **5**

Number of Contact Hours : **72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Understand the mobile platform.
2. Understand the mobile User Interface differs from Computer's user Interface.
3. Understand synchronization of data in mobile environment.
4. Create code using Android.
5. Remember various communication models.
6. Understand mobile screen and graphics.

Course Outline

Module 1: Introduction to Mobile Computing, Introduction to Android Development Environment. Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User.

Module 2: More on User Interface, VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multimodal UIs, Intents and Services, Android Intents and Services

Module 3: Characteristics of Mobile Applications, Successful Mobile Development, Storing and Retrieving Data, Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider

Module 4: Communications Via Network and the Web, State Machine, Correct Communications Model, Android Networking and Web, Telephony, Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony.

Module 5: Notifications and Alarms, Performance, Performance and Memory Management, Android Notifications and Alarms, Graphics, Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia. Location, Mobility and Location Based Services.

Reference

1. Mark Lassoff, Mr Tom Stachowitz*, Mobile App Development with HTML5*, 2015, LearnToProgram.
2. Can Bilgin, *Hands-On Mobile Development with NET Core*, 2019, Packt
3. Christian Keur, *iOS Programming: The Big Nerd Ranch Guide*, 2016-Big Nerd Ranch Guides.
4. Kristin Marsicano, Chris Stewart, Bill Phillips, *Android Programming: The Big Nerd Ranch Guide*, 2017, Big Nerd Ranch Guides.
5. Reto Meier, *Professional Android*, 2017-Wiley
6. Pradeep Kothari (Author), Kogent Learning Solutions Inc., *Android Application Development*, 2014, Dreamtech Press.
7. Horton John, *Android Programming for Beginners*, 2015, Packt
8. Jerome F. Dimarzio-, *Beginning Android Programming with Android Studio*, 2016, Wrox.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10

Assignment /seminar 5

Attendance 5

End semester assessment

Question pattern	**Marks**	**No. of Questions**	**Total Marks**
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**
			===

Sl. No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Understand the mobile platform	PO-1,4,6 PSO-1,2,8,4,9	U	C	6	6
CO 2	Understand how the mobile user Interface differs from Desktop computer's User Interface	PO-1,6 PSO-1,2,4,9	U	C	6	6
CO 3	Understand synchronization of data in mobile environment	PO-3,6 PSO-5,7,4,9	U	C	6	6
CO 4	Create code using Android	PO-2,3 PSO-3,4,5,7	Ap	C	6	6
CO 5	Remember various communication models	PO-2,3,4,5 PSO-3,4,5,7,8,6,9	U	C	6	6
CO 6	Understand mobile screen and graphics	PO-2,3,5 PSO-3,4,5,7,6,9	U	C	6	6

Core Course - XIII

Course Code	:	**VI B USIS 663**
Title	:	**Advanced Natural Language Processing**
Number of Credits	:	**4**
Hours per week	:	**5**
Number of Contact Hours	:	**72**

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember any language can be automated.
2. Analyze Language in an engineering point of view.
3. Understand the sibling nature of Linguistics and Mathematics.
4. Remember various steps in NLP.
5. Create a computational model for Sanskrit text processing.
6. Understand the various morphemes.
7. Analyze the tree structure of a sentence with possible parts of speech tags.

Module 1: Morphology: The study of structure, distributional behavior and use of words, descriptive methods of analysis, hierarchical word structure, morphological processes and rules, interaction of morphology with phonology and syntax. Contemporary theories including split morphology and single component architecture.

Module 2: Computational models of grammar, Chomsky hierarchy-regular, context free, context sensitive, unrestricted(free) grammar , Finite State Automata and its use in Linguistics.

Module 3: Automatic parsing, Semantic constraints, semantic net, dependency relations, Sandhi in Sanskrit words, Verbal database, Metrical pattern in Sanskrit verses, statistical language models, analysis of large text corpora.

Module4: Natural language semantics and programs that understand language, models of discourse structure, language used by intelligent agents, cognitive agents, gaining knowledge, contextual knowledge, agent oriented programming languages, tools and platforms.

Module5: Formal and Mathematical analysis of language models, Implementation of working programs that analyze and interpret NL text. Logic as a source of syntactical insights, Rule of grammar,

graphs for linguistics, Formalization of handwriting, The problem of linguistic equivalence, Linguistics and communication theory.

Reference

1. Bhargav Srinivasa-Desikan, *Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python*, Gensim, spaCy, and Keras"-2018-Packt.
2. Tanveer Siddiqui, *Natural Language Processing and Information Retrieval*, 2008, Oxford.
3. Geert Booij, *The Grammar of Words: An Introduction to Linguistic Morphology*, 2007, Oxford.
4. Jochen Trommer, *The Morphology and Phonology of Exponence*, 2012, Oxford.
5. Phoevos Panagiotidis, *Categorial Features*, 2014-Cambridge.
6. Andrew Carstairs-McCarthy, *The Evolution of Morphology*, 2010, Oxford.
7. Rajendra Kumar, *Theory of Automata Languages and Computation*, 2010, Tata McGrawHill.
8. Hopcroft, *Introduction to Automata Theory, Languages and Computation*, 2008, Pearson.
9. Ralph Grishman, *Computational Linguistics: An Introduction*, Cambridge University Press.
10. Roland R. Hausser, *Foundations of Computational Linguistics: Human-Computer Communication in Natural Language*, Springer.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16

Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
Total			**80**
			===

Sl. No	The student should be able to	PO/PSO	CL	KC	Sessions/Hrs	
					Class	Lab
CO 1	Remember any language can be automated	PO-1,6 PSO-1,2,4,9	U	C	8	0
CO 2	Analyze Language in an engineering point of view	PO-3 PSO-5,7	An	C	8	0
CO 3	Understand the sibling nature of Linguistics and Mathematics.	PO-5 PSO-6,9	U	C	10	0
CO 4	Remember various steps in NLP.	PO-2,3 PSO-3,4,5,7	U	C	10	0
CO 5	Create a computational model for Sanskrit text processing.	PO-2,3,5 PSO 3,4, 5,7,6,9	Ap	C	5	15
CO 6	Understand the various morphemes.	PO-2,3,5 PSO-3,4, 5,7,6,9	U	C	12	0
CO 7	Analyze the tree structure of a sentence with possible parts of speech tags.	PO-2,3,5,6 PSO-3,4,5,7,6,9,4	An	C	12	0

Core Course – XIV

Choice Based Courses

Course Code : VI B USIS 664

Title : Nyaya Theory of Inference

Number of Credits : 4

Hours per week : 5

Number of Contact Hours : 72

Course Outcomes : After successful completion of the course, the student should be able to:

1. Remember the epistemological features of Indian Philosophy.
2. Remember the basic concepts of Indian Logic.
3. Remember the features and epistemology of Nyaya philosophy.
4. Understand the concept of Inference in Indian philosophy.
5. Recognize the process of Inference in Nyaya and other knowledge systems.
6. Understand in detail the Anumanakhanda of Nyasasiddhantamuktavali.
7. Evaluate the concept and process of Inference in Nyaya philosophy.
8. Correlate the Inference of Nyaya to the concepts of computational linguistics.

Course outline

Module I: General study : Epistemology in Indian Philosophy – the authority of Inference – Inference in Nyaya and other systems.

Module II : The methods of knowledge acquisition. Significance of Anumana - the concept of Vyapti. Svarthanumana and Pararthanimana. Pancavayanavakya. Concept of Hetu and its different types - concept of Hetvabhasa and the varieties of Hetvabhasas.

ModuleIII: Detailed Study of Anumanakhanda of *Nyayasiddhantamuktavali* of Visvanathapancanana.

Module IV : Navyanyaya methodology as a tool for knowledge acquisition. The logical relation of the Nyaya method of comprehension.

Core Reading:

Nyayasiddhantamuktavali of Visvanathapancanana.

General Reading List

- Anantanarayana Sastri, Tarkasara.
- Hiriyanna, M, *An Outline of Indian Philosophy*, Motilal Banarsidass, Publishers, Delhi.
- Surendranath Dasgupta, *A History of Indian Philosophy*, VI Vols, Motilal Banarsidass Publishers P.Ltd., Delhi.
- Vasudeva Bhattathiri, C.V. *Bhartiya Darsanagal* (In Malayalam), Sahityapravartaka Sahakarana Sangham, Kottayam.

- Damodaran, K., *Bharatiyacinta* (Malayalam), Kerala Bhasha Institute, Thiruvananthapuram.
- Dr. T. Aryadevi, *Nyasastrapravesika*, Published by the Author, Trissur, 2005.
- Dr. T. Aryadevi, *Tarkasangrahadipika,* (Translation and Commentary), Kerala Sahitya Academi, Trissur, 2009.
- Muni Narayanaprasad, *Nyayadarsanam*, Narayan Gurukulam, Varkala, 2003.
- Prof. R. Vasudevan Potti, *Sastravadavali,* Sukritindra Oriental Research Institute, Tammanam, Kochi, 2004.
- Prof. V.N.Jha, *Contribution of Nyaya System to Indian Thought Structure*, Department of Sanskrit, University of Calicut, 1994.
- Prof. Mukundarajan, *Bharatiyanyayasastravum Adhunikaganitavum*, Kerala Sastra Sahitya Parishad, Kozhikode, 1990.

Assessment

Internal assessment	20 Marks
End semester assessment	80 Marks

Internal assessment

Class test	10
Assignment /seminar	5
Attendance	5

End semester assessment

Question pattern	Marks	No. of Questions	Total Marks
Objective type	1	10	10
Short answer	2	8 out of 12	16
Short essays	4	6 out of 9	24
Essays	15	2 out of 4	30
	Total		**80**

Sl. No	The student should be able to	PO/PSO	CL	KC	Class Hrs
CO 1	Remember the epistemological features of Indian Philosophy.	PO-1, 2 PSO-2,4	R	F	8

CO 2	Remember the basic concepts of Indian Logic.	PO-1, PSO-2,5	R	C	8
CO 3	Remember the features and epistemology of Nyaya philosophy.	PO-1, 3 PSO-2,4,5	R	F	7
CO 4	Understand the concept of Inference in Indian philosophy.	PO-1,3 PSO-2,4,5	U	C	8
CO 5	Recognize the process of Inference in Nyaya and other knowledge systems.	PO-1, 3 PSO-2,4,5	U	C	8
CO 6	Understand in detail the Anumanakhanda of *Nyasasiddhantamuktavali*.	PO-1, 3 PSO-2,4,5	U	C	19
CO 7	Evaluate the concept and process of Inference in Nyaya philosophy.	PO-1, 3 PSO-1,3,5	E	C	8
CO 8	Correlate the Inference of Nyaya to the concepts of computational linguistics.	PO-1, 3 PSO-1,3,5	E	C	8

Other Choice Based Courses

1) Vyakarana - Karakam -*Siddhantakaumudi*
2) Mimamsa - *Mimamsanyayaprakasa*
