Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus

Bachelor of Science (Artificial Intelligence)

Submitted by

Board of Studies,

Bachelor of Science (Artificial Intelligence)

FYUGP-Scheme I-VIII Semester
Bachelor of Science (Honors/Research)
(Artificial Intelligence -Major)
Four Year (Eight Semester Degree Course)
Teaching and Examination Scheme

B.Sc. Sem-I (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Programming with C++	BAI1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Programming with C++	BAI1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Operating Systems and Linux	BAI1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Operating Systems and Linux	BAI1P02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSEC	Refer VSC Basket	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	VSEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**530**	**170**		**125**	**275**	

B.Sc. Sem-II (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Introduction to Python	BAI2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Introduction to Python	BAI2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Discrete Mathematical Structure	BAI2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Discrete Mathematical Structure	BAI2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSEC	Refer VSC Basket	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	VSEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	**22**		**450**	**150**		**175**	**325**	

B.Sc. Sem-III (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Introduction to Artificial Intelligence	BAI3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Introduction to Artificial Intelligence	BAI3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Database Management System	BAI3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Database Management System	BAI3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSEC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-IV (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Data Structure using Python	BAI4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Data Structure using Python	BAI4P07	-	-	2	1	-	-	-	-	25	25	25
3	DSC	SQL/PLSQL	BAI4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	SQL/PLSQL	BAI4P08	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	VSEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	**22**		**450**	**150**		**150**	**350**	

B.Sc. Sem-V (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Advanced Python Programming	BAI5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Advance Python Programming	BAI5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Machine Learning	BAI5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Machine Learning	BAI5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Digital Electronics and Microprocessor	BAI5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Digital Electronics and Microprocessor	BAI5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 1	BAI5T12	2	-	-	2	3	80	20	40	-	-	-
8	DSE	Elective 1	BAI5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSCE	Refer VSC Basket	BVS5P07	-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service	BCM5P02	-	-	2	1	-	-	-	-	25	25	25
Total				**13**	**-**	**18**	**22**	**-**	**520**	**130**	**--**	**150**	**300**	**-**

B.Sc. Sem-VI (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Big Data Analytics	BAI6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Big Data Analytics	BAI6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Cloud Computing	BAI6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Cloud Computing	BAI6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Cyber Security	BAI6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Cyber Security	BAI6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 2	BAI6T16	2	-	-	2	3	80	20	40	-	-	-
8	DSE	Elective 2	BAI6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSCE	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	**22**		**440**	**110**		**225**	**225**	

B.Sc. Sem-VII (Honors) (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Deep Learning	BAI7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Deep Learning	BAI7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Natural Language Processing	BAI7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Natural Language Processing	BAI7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Reinforcement Learning	BAI7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Reinforcement Learning	BAI7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Data Visualisation	BAI7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Data Visualisation	BAI7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 3	BAI7T21	2	-	-	2	3	80	20	40	-	-	-
10	DSE	Elective 3	BAI7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BAI7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BAI7P022	-	-	2	1	-	-	-	-	50	50	50
Total				13	-	14	**20**		**520**	**130**		**125**	**125**	

B.Sc. Sem-VIII (Honors) (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Fuzzy Logic and Genetic Algorithm	BAI8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Fuzzy Logic and Genetic Algorithm	BAI8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	R- Programming	BAI8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	R- Programming	BAI8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Neural Network	BAI8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Neural Network	BAI8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Soft Computing	BAI8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Soft Computing	BAI8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	Elective 4	BAI8T27	2	-	-	2	3	80	20	40	-	-	-
10	DSE	Elective 4	BAI8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

B.Sc. Sem-VII (Research) (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Deep Learning	BAI7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Deep Learning	BAI7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Natural Language Processing	BAI7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Natural Language Processing	BAI7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Reinforcement Learning	BAI7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Reinforcement Learning	BAI7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 3	BAI7T20R	2	-	-	2	3	80	20	40	-	-	-
8	DSE	Elective 3	BAI7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BAI7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BAI7P021R	-	-	2	1	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	**20**		**440**	**110**		**175**	**275**	

'R' in the subject code indicates 'Research'.

B.Sc. Sem-VIII (Research) (Artificial Intelligence -Major)

SN	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Fuzzy Logic and Genetic Algorithm	BAI8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Fuzzy Logic and Genetic Algorithm	BAI8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	R- Programming	BAI8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	R- Programming	BAI8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Neural Network	BAI8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Neural Network	BAI8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	Elective 4	BAI8T25R	2	-	-	2	3	80	20	40	-	-	-
8	DSE	Elective 4	BAI8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2+1)	-	-	-	-	175	175	175
Total				09	-	22	**20**		**360**	**90**		**225**	**325**	

'R' in the subject code indicates 'Research'.

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Artificial Intelligence)

Semester	Course Category	Name of Course	BoS	Course Code
I	**VSC**	Office Automation	Inter disciplinary program in Science (Artificial Intelligence)	BVS1P01
II	**VSC**	Computer Animation	Inter disciplinary program in Science (Artificial Intelligence)	BVS2P03
III	**VSC**	Web design using HTML and DHTML	Inter disciplinary program in Science (Artificial Intelligence)	BVS3P05
V	**VSC**	Web Development using Java	Inter disciplinary program in Science (Artificial Intelligence)	BVS5P07
VI	**VSC**	Shell Programming	Inter disciplinary program in Science (Artificial Intelligence)	BVS6P08

Basket for ELECTIVE (DSE) Category Courses (Artificial Intelligence)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Computer Graphics	BAI5T12
		B. Software Engineering	
VI	Elective 2	A. Optimization Techniques	BAI6T16
		B. Internet of Things	
VII (Honors)	Elective 3	A. Pattern Recognition	BAI7T21
		B. Probability and Statistics	
VIII (Honors)	Elective 4	A. Data Mining	BAI8T27
		B. Operation Research	
VII (Research)	Elective 3	A. Text Analytics	BAI7T20R
		B. Theory of Computation	
VIII (Research)	Elective 4	A. Block chain Technology	BAI8T2R
		B. Parallel Computing	

'R' in the subject code indicates 'Research'.

Bachelor of Science (Honors/Research)
(Artificial Intelligence - Major)
Four Year (Eight Semester Degree Course)

The objectives of the Program

1. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

2. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

3. Identify problems where artificial intelligence techniques are applicable and demonstrate ability to share in discussions of AI, its current scope and limitations, and societal implications.

4. Demonstrate proficiency in applying scientific method to models of machine learning.

5. Develop an appreciation for what is involved in Learning models from data by understanding a wide variety of learning algorithms and by understanding of the strengths and weaknesses of many popular machine learning approaches

6. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the ML models.

7. Consider the pros and cons when choosing ML / AI methods for different applications

8. Appreciate the underlying mathematical relationships within and across Machine Learning an AI conduct investigations of complex problems by using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Discipline knowledge: Acquiring knowledge on basics of Computer Science and ability to apply to design principles in the development of solutions for problems of varying complexity.

2. Problem Solving: Improved reasoning with strong mathematical ability to Identify, formulate and analyze problems related to computer science and exhibiting a sound knowledge on data structures and algorithms.

3. Design and Development of Solutions: Ability to to prepare students to apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

4. Programming a computer: Exhibiting strong skills required to program a computer for various issues and problems of day-to-day scientific applications.

5. Application Systems Knowledge: Possessing a minimum knowledge to practice existing computer application software. Provide opportunity for statistical analyses with professional statistical software

6. Communication: Must have a reasonably good communication knowledge both in oral and writing.

7. Ethics on Profession, Environment and Society: Exhibiting professional ethics to maintain the integrity in a working environment and also have concern on societal impacts due to computer-based solutions for problems.

8. Lifelong Learning: Should become an independent learner. So, learn to learn ability.

9. Motivation to take up Higher Studies: Inspiration to continue educations towards advanced studies on Computer Science.

B.Sc. Sem-I (Artificial Intelligence –Major)
SC-DSC (Paper I)
BAI1T01
Programming with C++

Credits: 2 **Duration :30 Hours**

Course Objectives:
1. To provide basic characteristics of OOP through C++.
2. To impart skills on various kinds of overloading and inheritance.
3. To introduce pointers and file handling in C++ together with exception handling mechanism.

Course Outcomes:
After completion of this course, students will be able to:
1. Realize the need and features of OOP and idealize how C++ differs from C.
2. Infer knowledge on various types of overloading.
3. Choose suitable inheritance while proposing solution for the given problem.
4. Handle pointers and effective memory management.
5. Illustrate application of pointers in virtual functions.

UNIT – I
Introduction to Object Oriented Programming: Introduction, Characteristics of OOPs, Advantages of OOPs, Disadvantages of OOPs, **Data Types, Operators and Expressions:** Identifiers & Keywords, Data Types, C++ Operators, Type Conversion. **Input and Output Streams:** Comments, Declaration of Variables, Simple C++ Programs, Manipulator Functions, Input and Output (I/O) **Control Statements:** Conditional Expressions, Loop Statements, Nested Control Structures, Breaking Control Statements.

UNIT – II
Function and Program Structures: Introduction, Defining a Function, Return Statement, Types of Functions, Actual & Formal Arguments, Local & Global Variables, Default Arguments, Structure of C++ Program, Order of the Function Declaration, Scope Rules, Storage Class Specifiers, Recursive Function **Arrays:** Introduction, Array Notation, Array Declaration, Array Initialization, Processing with Arrays, Character Array. **Pointers and Strings:** Introduction, Pointer Arithmetic, Pointers and Functions, Pointers and Arrays, Pointer and Strings.
Structures and Unions Introduction, Declaration of Structure, Processing with Structures, Initialization of Structures, Functions and Structures, Array of Structure, Pointer and Structure, Unions.

UNIT – III
Classes and Objects: Introduction, Structures and Classes, Declaration of Class, Member Functions, Defining the Object of a Class, Accessing a Member of Class, Array of Class Objects, Pointer and Classes. **Special Member Function:** Introduction, Constructors, Destructors, Inline Member Functions, Static Class Members, Friend Function, This Pointer. **Single and Multiple Inheritance:** Introduction, Single Inheritance, Types of Base Classes, Type of Derivation, Multiple Inheritance, Member Access Control.

UNIT-IV
Overloading Functions and Operators: Function Overloading, Operator Overloading, Overloading of Binary Operators, Overloading of Unary Operators. **Polymorphism and Virtual Functions:** Polymorphism, Virtual Functions, Pure Virtual Functions, Abstract Base Classes, Virtual Base Classes.

Text Book

1. D. Ravichandran, Programming with C++, McGraw-Hill.**Reference Books:**

1. E. Balaguruswamy, Object Oriented Programming with C++, McGraw-Hill.
2. Rohit Khurana, Object Oriented Programming with C++, Vikas Publishing House Pvt. Ltd.
3. Anirban Das, Goutam Panigrahi, Object Oriented Programming with C++, Vikash Publishing House Pvt. Ltd.
4. Herbert Schildt, The Complete Reference – C++, McGraw-Hill.

B.Sc. Sem-I (Artificial Intelligence –Major)
SC-DSC (Paper II)
BAI1T02
Operating Systems and Linux

Credits: 2 **Duration :30 Hours**

Course Objectives:
1. To introduce the Operating system concepts and designs to provide the skills required to implement the OS services.
2. To describe the trade-offs between contradictory objectives in large scale OS system design.
3. To develop the knowledge for application of the various OS design issues and services.
4. To understand structure of Linux OS and commands.

Course Outcome:
After completion of this course, students will be able to:
1. Describe the various OS functionalities, structures and layers.
2. Usage of system calls related to OS management and interpreting different stages of various process states.
3. Design CPU scheduling algorithms to meet and validate the scheduling criteria.
4. Apply and explore the communication between inter process and synchronization techniques.
5. Implement memory placement strategies, replacement algorithms related to main memory and virtual memory techniques.
6. Differentiate the file systems; file allocation, access techniques along with virtualization concepts and designing of OS with protection and security enabled capabilities.
7. Working on Linux OS.

UNIT - I:
Structure of Operating System, Operating System functions, Characteristics of Modern OS. Process Management: Process states, Creation, Termination, Operations on Process, Concurrent process, Processes Threads, Multithreading, Micro Kernels CPU Scheduling: Schedulers, Scheduling Methodology, CPU Scheduling Algorithm: FCFS, SJF, RR, Priority Scheduling.

UNIT – II:
Performance comparison : Deterministic Modeling , Queuing analysis, Simulators. Deadlock and Starvation: Resource Allocation Graph, Conditions for Dead Lock, Dead Lock Prevention, Dead Lock Detection, Recovery from Deadlock.

UNIT - III:
Memory Management: Logical Vs. Physical Address Space, Swapping, Memory Management Requirement, Dynamic Loading and Dynamic Linking, Memory Allocation Method: Single Partition allocation, Multiple Partitions, Compaction, paging, segmentation, File Management: File Management system, File Accessing Methods, File Directories, File Allocation Methods

UNIT - IV:
Anatomy of Linux OS, Directory Structure, /usr Directory, File Types: User datafiles, System data files, Executable files. Naming files and directories. Shell: Creating User Account, Shell Program, bash shell, Changing shell prompt. Commands: Basic Syntax for a command, Exploring the Home Directory, ls, mkdir, rmdir, stat, cat, rm, mv, cp, Managing users accounts, Changing Password, Creating group accounts.

Text Books:
1. Operating Systems by P. Balakrishna Prasad [Scitech Publication]
2. Operating System Concept : Silbershaz (Addision Education)
3. SAMS Teach Yourself Linux by Craig and Coletta Witherspoon [Techmedia]

Reference Books:
1. Operating Systems - H.M. Deitel - Addision Wesley.
2. Operating Systems- John J. Donoven.
3. Operating System : A. S. Godbole (TMH)
4. Modern Operating Systems : Tenenenbaum (Pearson Education)

B.Sc. Sem-I (Artificial Intelligence –Major)
BVS1P01
OFFICE AUTOMATION

Credits: 2 **Duration: 60 Hours**

Course Objectives:

1. To understand functionality of Operating Systems and its applications.
2. To understand the working with the user interface.
3. To understand Word Processing, their usage, details of word processing screen, Opening, saving and printing a document
4. To understand Worksheet creation, inserting and editing data in cells.

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

1. Understand functionality of Operating Systems and its applications.
2. Working with the user interface.
3. Prepare documents, letters and do necessary formatting of the document.
4. Worksheet creation, inserting and editing data in cells.
5. Opening/saving a presentation and printing of slides and handouts.

UNIT I

Introduction to windows Operating System Advantages of windows operating system, using different windows applications simultaneously, operating with windows, GUI, use of help features, starting an application, essential accessories, creating shortcuts, windows explorer, control panel, my computer, my documents, recycle bin, finding folders and files, changing system settings, system tools, use of run command, setting peripherals, drivers, editing graphics in windows.

UNIT II

Introduction, basics, starting Word, creating document, parts of Word window, mouse and keyboard operations, designing a document; Formatting- selection, cut, copy, paste; Toolbars, operating on text; Printing, saving, opening, closing of document; Creating a template; Tables, borders, pictures, text box operations; Mail Merge.

UNIT III

Introduction to MS EXCEL, navigating, Excel toolbars and operations, Formatting; copying data between worksheets; entering formula, chart creation; data forms, data sort; Functions in Excel ROUND( ), SQRT ( ), MAX( ), MIN( ), AVERAGE( ), COUNT( ), SUMIF( ), SUMIF( ), ABS( ), ROMAN( ), UPPER( ), LOWER( ), CELL( ), TODAY( ), NOW( ).

UNIT IV

Introduction to MS POWER POINT Working with Power Point Window, Standard Tool Bar, Formatting tool bar, Drawing tool Bar, Moving the Frame, Inserting Clip Art, Picture, Slide, Text Styling, Send to back, Entering data to graph, Organization Chart, Table,Design template, Master Slide, Animation Setting, Saving and Presentation , auto Content Wizard.

Text Books:

1. MS Office XP for Everyone by Sanjay Saxena (Vikas Publi, Noida)
2. MS-Office 2000(for Windows) By Steve Sagman
3. A First Course in Computers – Sanjay Saxena

B.Sc. Sem-I (Artificial Intelligence –Major)
BVE1T01

ENVIRONMENTAL SCIENCE

Credits: 2 **Duration :30 Hours**

COURSE OUTCOMES:
At the end of the course, students shall be able to:

1. Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
2. Explicate the importance of Environmental Education.
3. Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
4. Describe the various physical and chemical characteristics and properties of Water and Soil
5. Understand the Ecology and its allied branches
6. Comprehend about Population and Community Ecology
7. Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.

B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.

C. Components of Environment: Atmosphere (Structure and composition), hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.

B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.

C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.

B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.

C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)

B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.

C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr. P.U. Meshram, Allied Publishers, New Delhi.
8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi, Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher, Bikaner,1994

B.Sc. Sem-I (Artificial Intelligence –Major)
Indian Knowledge System (IKS)
BIK1T01
VEDIC MATHEMATICS

Credits : 2 **Duration :30 Hours**

Course Outcomes: This course will enable the students to
1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. Gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i)Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum -Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	**8**
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhwajank(ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	**8**
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	**7**
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	**7**
	Total	**30Hrs**

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, Motilal Banarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution of Civil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5, 3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

B.Sc. Sem-II (Artificial Intelligence –Major)
SC-DSC (Paper I)
BAI2T03
Introduction to Python

Credits : 2 **Duration : 30 Hours**

Course Objectives:

The course is designed to teach:

1. The Python environment, data types, operators used in Python.
2. The use of control structures and numerous native data types with their methods.
3. The design and implement user defined functions, modules, and packages and exception handling methods.
4. Creating and handling files in Python
5. Object Oriented Programming Concepts
6. The semantics of Python programming language and illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.

Course Outcomes:

After completing this course satisfactorily, a student will be able to:

1. Interpret the basic principles of Python programming language
2. Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism, code reuse as used in Python
3. Solve, test and debug basic problems using python script
4. Manipulate python programs by using the python data structures like lists, dictionaries, tuples, strings and sets.
5. Design object-oriented programs with Python classes.
6. Identify the commonly used operation involved in files for I/O processing
7. Familiarize the handling of I/O Exceptions and usage of Directories, Identify the commonly used operations involving file systems and regular expressions.

Unit I

Introduction to Python: use of Jupyter / IDLE/ CoLAB to develop programs, Features of Python, Limitations, Major Applications of Python types and variables, working with numeric data, working with string data, **Python Data Types & Input/Output:** Keywords, Identifiers, Python Statement, Indentation, Documentation, Variables, Multiple Assignment, Understanding Data Type, Data Type Conversion, Python Input and Output Functions, Import command. **Operators and Expressions**: Operators in Python, Expressions, Precedence, Associativity of Operators, Non-Associative Operators, Interactive Mode and Script Mode, Order of Operations. **Control Structures**: Decision making statements, loops, control statements. **Python Native Data Types:** Numbers, Lists, Tuples, Sets, Dictionary, Functions & Methods of Dictionary

Unit II

Strings: String as a sequence, traversal with a for loop, string slices and dices, strings Are immutable, searching, looping and counting, string methods, the in operator, string comparison, string operations
Python Functions: Function calls, type conversion functions, math functions, user defined functions - definitions and uses, parameters and arguments, variables and parameters Are Local, stack diagrams, fruitful functions and void functions, importing with from, return values, composition, boolean functions, recursion, checking types

Unit III

Python Modules: Module definition, need of modules, creating a module, importing module, Path Searching of a Module, Module Reloading, Standard Modules, Python Packages. **Classes in Python**: OOPS Concepts, Classes and objects, Classes in Python, Constructors, Data hiding, Creating Classes, Instance Methods, Instances as return values, Special Methods, Class Variables, Inheritance, Polymorphism, Type Identification, Custom Exception Classes, Iterators, generators and decorators.

Unit IV

File Management in Python: Operations on files (opening, modes, attributes, encoding, closing), read() & write() methods, tell() & seek() methods, renaming & deleting files in Python, directories in Python. **I/O and Error Handling in Python**: Introduction, Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Working with Directories. **Exception Handling:** Exceptions, Built-in exceptions, Exception handling, User defined exceptions in Python, Handling IO Exceptions, Errors, Run Time Errors, The Exception Model, Exception Hierarchy, Handling Multiple Exceptions.

Text Books:

1. Pooja Sharma, Programming in Python, BPB Publications, 2017, ISBN: 978- 9386551276
2. R. NageswaraRao, Core Python Programming, Dreamtech Press, 3rd Edition, ISBN: 978-9390457151

Reference Books:

1. Dr. Marlapalli Krishna, S. Jaya Prakash, K. Varada Rajkumar, Basic Python Programming for Beginners, Bluerose Publishers Pvt. Ltd., 2021, ISBN: 978- 9354720604
2. Martin C. Brown, Python: The complete Reference, McGraw Hill Education, 2018, ISBN: 978-9387572942
3. Martelli A., A. Ravenscroft, S. Holden, Python in a Nutshell, OREILLY.
4. Reema Thareja, Python Programming, OUP India, Oxford University Press India, 2nd edition, 2023, ISBN: 978-9354973765
5. Christos Manola, Dimitrios Xanthidis, Han-I Wang, Ourania K. Xanthidou, Handbook of Computer Programming with Python, CRC Press; 1st edition, 2022, ISBN: 978- 0367687779

B.Sc. Sem-II (Artificial Intelligence –Major)
SC-DSC (Paper II)
BAI2T04
Discrete Mathematical Structure

Credits: 2 **Duration : 30 Hours**

Course Objectives:

The course is designed to teach:

1. To introduce the concepts of mathematical logic
2. To introduce the concepts of sets, relations, and functions.
3. To perform the operations associated with sets, functions, and relations.
4. To introduce generating functions and recurrence relations.
5. To relate practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context.
6. To use Graph Theory for solving problems

Course Outcomes:

On completion of this course you should be able to:

1. Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees
2. Produce convincing arguments, conceive and/or analyses basic mathematical proofs and discriminate between valid and unreliable arguments.
3. Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems

UNIT- I:

Fundamental – Sets and Subsets, operations on sets, sequence, Division in the integer, Matrices, Mathematics Structures. Logic-Proposition and Logical Operation Conditional Statements, Methods of Proof, Mathematical Induction, **Mathematical Logic-** Statements and Notation, Connectives, well-formed formula, Duality law.

UNIT- II:

Functions - definition, types of function, Invertible functions composition of functions.
Counting - Permutation, Combinations, The pigeonhole principle, recurrence relation, Mathematical Induction.

UNIT- III:

Algebraic Structures

Semi groups & groups: Binary operations, Semi groups, isomorphism and Homomorphism, Product and Quotient of semi groups, Groups, subgroups, products and Quotient of groups.
Lattices: - Lattice concepts, isomorphic Lattices, Properties of lattices, Finite Boolean algebras.

UNIT- IV:

Graph Theory: Basic Terminology, Models and Types, Multigraphs and Weighted Graphs, Graph Representation, Graph Isomorphism, Connectivity, Euler and Hamiltonian Paths and Circuits, Planar Graphs, Graph Coloring, Trees, Basic Terminology and Properties of Trees, Introduction to Spanning Trees

Text Books:

1. Discrete Mathematical Structures with applications to computer Science By J,P.Tremblay & R. Manohar, (TMH)
2. Discrete Mathematical Structures by Kolman Busby and Ross (Pearson)
3. Discrete Mathematics By Norman Biggs. (Oxford).

Reference Books:

1. Logic and Discrete Mathematics : Grassmann, Tremblay (Pearson)
2. An introduction to the theory of computer science , languages and machines : Sudkamp
3. Kenneth H Rosen Discrete Mathematics & it's Applications TMH

B.Sc. Sem-II (Artificial Intelligence –Major)
BVS2P03
COMPUTER ANIMATION

Credits : 2 **Duration : 60 Hours**

Course Objectives:

1. To understand the concept of 2D and 3D Animation.
2. To execute creative concepts and ideas through a variety and combination of techniques including hand drawn, computer generated, 2D and 3D storyboards and animatic.
3. To understand how animation works.
4. To understand the basic concepts of multimedia technology which will help them to get started easily in multimedia.

Course Outcome: After completion of this course, students will be able to:

1. Get knowledge about various terms like, images, text, fonts, file formats. Understanding these things is very necessary.
2. Produce traditional style animation as well as puppet animation and the knowledge of the principles of animation to be built upon in subsequent courses leading up to the Portfolio course.
3. Apply skills learned in this class in other areas including motion graphics, stop motion and basic traditional animation

Unit I

Animation, Introduction to 2D and 3D Animation. Advantages of animation, Different tools of 2D Animation. **GIMP** Features and Capabilities, Toolbox, Image Window, Dialog and Docking, Working with images, **Pencil2D** , Overview of Pencil2D, Traditional Animation Workflows, How to rotate image, Scrolling background in Camera layer.

Unit II

Opentoonz, Production Workflow, Interface Overview, Managing Projects, Setting Up a Scene, Scanning Paper Drawings, Cleaning-up Scanned Drawings, Drawing Animation Levels, Editing Animation Levels, Managing Palettes and Styles, Painting Animation Levels, Working in Xsheet/Timeline, Creating Movements, Editing Using Spreadsheet and Curves, Creating Cutout Animation, Create animations using Plastic tool, Applying Effects, Using the Particles Effect, Previewing and Rendering

Unit III

Blender, History and Installation, Interface : Blender Interface, Adding New Objects, Moving Things Around, Modeling : Mesh, Edit Mode, Sculpt Mode, Retopology Lighting and Procedural Textures : Setting Up a Basic Scene, The Scene Camera, Procedural Materials and Textures., UV Mapping : Creating a UV Map, Texture Painting, Projection Painting, Normal Maps and Bump Maps Curves and NURBS : Metaballs, Curves, Spins, Nurbs,

Unit IV

Basic Rigging and Animation : Keyframing with the Timeline, The Dopesheet ., Parenting, Graph Editor, Pivot Point: The Center of Rotation, Basic Tracking: Eyes That Follow, Rigging with Bones, Rigging a Simple Character, Advanced Rigging ..: Forward Kinematics vs. Inverse Kinetics, Blender 2.5 Rigs, Walk Cycles., Shape Keys, Lip Syncing. Making Movies : Disabling, Color Management, Rendering Formats, Alpha, Lighting Adjustments, The Video Sequence Editor, Crash Management and Rendering Speed, Introduction to Game Engine.

Text Books :

https://docs.gimp.org/odftest/en.pdf
https://opentoonz.readthedocs.io/en/latest/using_the_toonz_farm.html
https://www.pencil2d.org/doc/tutorials
Beginning Blender Open Source 3D Modelling, Animation, and Game Design, Lance Flavell, Apress.

Reference Book :

Learning Blender A Hands-On Guide to Creating 3D Animated Characters, Oliver Villar
Blender Basics Classroom Tutorial Book 4th Edition, James Chronister.
https://www.cdschools.org/cms/lib04/pa09000075/centricity/domain/81/blenderbasics_4thedition2011.pdf
Blender 3D Basics Beginner's Guide: A quick and easy-to-use guide to create 3D modeling and animation using Blender 2.7, Gordon Fisher

B.Sc. Sem-II (Artificial Intelligence –Major)
BVE2T02
CONSTITUTION OF INDIA

UNIT – I:
• Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II
• Preamble - Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity
• Salient Features of the Constitution of India

UNIT – III
• General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV
Introduction of the Constitutional Institutions and Authorities;
• Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
• State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
• Higher Judiciary (Supreme Court of India and High Courts)

B.Sc. Sem-II (Artificial Intelligence –Major)
Indian Knowledge System (IKS)
BIK2T02
INDIAN ASTRONOMY

Course Outcomes: This course will enable the students to understand that
1. It is possible to create a map of the intellectual growth of a culture using astronomy as a probe.
2. The growth of Indian astronomy occurs in distinct stages analogous to phase transitions of the evolution of cultures
3. Indian Astronomy therefore provides an excellent window to the past dramatic transitions.

Units	Topics	Hours
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	**8**
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	**8**
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	**7**
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	**7**
	Total	**30 Hrs**

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao. Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan, Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India, https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin%20of%20Astronomy.pdf