ANNEXURE II

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Scheme of Teaching & Examination of Bachelor of Technology

I Semester B.Tech. (Artificial Intelligence)

Sr No	Category	CourseCode	Course Name	Concern BOS	Teaching Scheme Hrs/ Week			Total Credits	Examination Scheme						
									Theory				Practical		
					L	T	P		Exam Hours	SEE	CIE	Min	SEE	CIE	Min
1	BSC - I	BAI1T01	Essentials of Chemistry	ASH	2	0	0	2	3	70	30	45	-	-	-
2	BSC – I	BAI1P01	**Lab:** Essentials of Chemistry	ASH	0	0	2	1	-	-	-	-	25	25	25
3	BSC – II	BAI1T02	Basic calculus & differential equations	ASH	3	0	0	3	3	70	30	45	-	-	-
4	ESC – I	BAI1T03	Digital Circuits & Logic Design	ET in E&T	3	0	0	3	3	70	30	45	-	-	-
5	ESC – I	BAI1P03	**Lab:** Digital Circuits & Logic Design	ET in E&T	0	0	2	1	-	-	-	-	-	50	25
6	ESC – II	BAI1T04	Programming for problem solving	ET in E&T	3	0	0	3	3	70	30	45	-	-	-
7	ESC – II	BAI1P04	Programming for problem solving Lab	ET in E&T	0	0	2	1	-	-	-	-	25	25	25
8	VSC - I	BVS1P01	UI/UX	ET in E&T	0	0	4	2	-	-	-	-	50	50	50
9	AEC-I	BAE1T01	Communication Skills	ASH	1	0	0	1	2	35	15	23	-	-	-
10	AEC-I	BAE1P01	Lab: Communication Skills	ASH	0	0	2	1	-	-	-	-	25	25	25
11	CC – I	BCC1P01	Refer CC Basket	ASH	0	0	4	2	-	-	-	-	-	100	50
Total					**13**	**0**	**14**	**20**	-	**315**	**135**	-	**125**	**275**	-

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

I Semester

Course Title	Essentials of Chemistry	Course Code	BAI1T01
Teaching Hours / Week	02 Th	Total Credits:	02
CIE	30 Marks	SEE	70 Marks

Course Objectives:

1	To introduce ideas of electrochemistry necessary to understand the function of batteries.
2	To gain an understanding of the rare earth metals and waste handling generated out of their uses.

Course Outcomes:

CO1	Students will be able to utilize the basics concepts of battery technology & energy storage devices.
CO2	Students will learn about rare earth elements, the correct disposal methods of e-wastes and while creating any tool they will keep this environmental aspect in mind.
CO3	They will know the role of nanomaterials and their applications.
CO4	Students will inculcate the use of instrumentation techniques and interpret its applications in material characterization.

SYLLABUS

Unit-1 : Battery Technology (6 hours)

Electrochemical & Galvanic Series, Electrochemical & Electrolytic cells Battery: Introduction, types- primary, secondary and reserve, Lithium-cobalt oxide and metal air batteries - characteristics, components/materials, working and applications.

Super capacitors: Introduction, types (EDLC, pseudo and asymmetric capacitor) with examples and applications.

Energy conversion devices: Introduction, characteristics, materials, working and applications of H2-O2 fuel cells, amorphous Si and quantum dye sensitized solar cells.

UNIT 2: Rare earth elements and E-wastes management (6 hours)

Rare earth elements: Properties, applications in electronics. Lanthanide contraction. Types of E-wastes, environmental and health risks, segregation and recycling (Hydrometallurgical, pyrometallurgical and direct recycling), Extraction of rare earth and precious metals from e-wastes,

Twelve principles of Green Chemistry. Green Computing, Role of Green Computing in Environment and Research, Green devices and Green data Servers.

UNIT 3: Nanomaterials (6 hours)

Introduction, classification, size dependent properties, surface area, optical and catalytic properties, Synthesis methods of nanomaterials- Top down and bottom-up approach. Carbon nanomaterials: Types, properties and applications of CNT and graphene. Applications of nano materials.

UNIT 4: Material Characterization Techniques (6 hours)

Principles and applications of –

Electronic Spectroscopy (Beer-Lambert's law and its numerical), Infra-Red spectroscopy and Nuclear Magnetic Resonance spectroscopy.
Thermal analysis (Thermogravimetry, Differential Thermal Analysis, Differential Scanning Calorimetry), Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Brunauer-Emmett-Teller (BET) surface area analysis, X-ray Diffraction Analysis, particle size analyser (Dynamic Light Scattering), High Performance Liquid Chromatography and Gas Chromatography

References/ Text Books

1. M Afshar Alam, Sapna Jain, Hena Parveen, Green Computing Approach Towards Sustainable Development, Wiley Interscience Publications.
2. S. S. Dara, A Textbook of Engineering Chemistry, S. Chand Publications
3. ShikhaAgrawal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press.
4. Supercapacitors and Their Applications Fundamentals, Current Trends, and Future Perspectives, Edited By Anjali Paravannoor, Baiju K.V, CRC Press
5. The Rare Earth Elements: An Introduction, JHL Voncken, Springer Link

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

I Semester

Course Title	Essentials of Chemistry Lab	Course Code	BAI1P01
Teaching Hours / Week	02 P	Total Credits:	01
CIE	25 Marks	SEE	25 Marks

Course Outcomes :

After completion of this course, the students will develop competencies in

1	Practical knowledge of handling chemical methods in skilled way.
2	Estimation of soluble impurities present in water sample.
3	Strengthening their theoretical knowledge while performing virtual lab experiments.

Sr. No.	Practical (Any Six)
1	Estimation of Copper estimation (iodometrically)
2	Estimation of Ni by complexometry / gravimetry.
3	Fe(II)/ (III) estimation by redox titration.
4	Beer's Law verification by spectrophotometer.
5	Separation of copper nickel ions by paper chromatography.
6	Redox titration by potentiometry
7	Acid base titration by potentiometry
8	Acid base titration by conductometry
9	Virtual Lab: Experiment on Chromatography
10	Virtual Lab: Experiment on Spectroscopy

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

I Semester

Course Title	Basic Calculus and Differential Equations	Course Code	BAI1T02
Teaching Hours / Week	03 Th	Total Credits:	03
CIE	30 Marks	SEE	70 Marks

Prerequisites :

Basic knowledge of fundamentals of mathematical concepts, matrices, differentiation, Integration.

Course Objectives :

1	The topics covered will equip them the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power.
2	The aim is to inculcate and develop the basic mathematic skills of engineering students that are imperative for effective understanding of engineering subjects.

Course Outcomes :

After completing the course, students will be able to

CO1	Analyse real world scenarios to recognize when derivatives or integrals are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret andclearly communicate the results.
CO2	Appreciate ODE and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.
CO3	Apply knowledge of mathematics, physics and modern computing tools to scientific and engineering problems.
CO4	Develop an ability to identify, formulate and/or solve real world problems.
CO5	Understand the impact of scientific and engineering solutions in a global and societal context.

SYLLABUS

Unit 1 : Differential Calculus (7 Hours)

Successive differentiation: Leibnitz's Rule, Taylor's and Maclaurin's series for function of one variable, Indeterminate forms and L'Hospital's Rule,

Unit 2 : Multivariable Calculus (Differentiation) (8 Hours)

Functions of several variables, First and Higher order partial derivatives, Euler's theorem, Chain rule and Total differential coefficient, Jacobians, Lagrange's method of undetermined multipliers.

Unit 3 : Matrices **(7 Hours)**

Rank of a matrix, Consistency of linear system of non-homogeneous equations, Linear dependence of vectors, Eigen values and Eigen vectors, Reduction to diagonal form, Cayley-Hamilton theorem.

Unit 4 : First Order Ordinary Differential Equations **(7 Hours)**

Linear, Reducible to linear and Bernoulli's differential equations, Exact differential equations (Excluding the cases of integrating factors), Application of first order differential equation to simple electrical circuits.

Unit 5 : Higher Order Ordinary Differential Equations **(7 Hours)**

Higher order ordinary linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations, Applications of higher order differential equations to simple electrical circuits.

Text/Reference Books :

(1) Erwin Krayzig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
(2) Ramana B.V., Higher Engineering Mathematics, Tata Mc-Graw Hill, New Delhi, 11th Reprint, 2010.
(3) N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
(4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
(5) P. N. Wartikar and J. N. Wartikar, Applied Mathematics, Volume I and II.
(6) H.K Dass, Rama Verma, Rajnish Verma, V.J. Dagwal, Sajid Anwar and D.F. Shastrakar, Engineering Mathematics, Volume I and II, S. Chand

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence I Semester			
Course Title	**Digital Digital Circuits & Logic Design**	**Course Code**	**BAI1T03**
Teaching Hours / Week	**03 Th**	**Total Credits:**	**03**
CIE	**30 Marks**	**SEE**	**70 Marks**

Course Objectives :	
1	Logic functions using Boolean algebraic theorems and techniques
2	Conventional combinational and sequential circuits including conversions of flip-flops.
3	The exploration of the semiconductor memories and programmable logic devices.
Course Outcomes :	
CO1	Outline binary arithmetic operations and optimize Boolean functions using Karnaugh map (k-map) method.
CO2	Apply combinational circuits for realization of basic building blocks of conventional digital circuits.
CO3	Design different flip flop circuits
CO4	Design different sequential circuits
CO5	Design applications of sequential logic circuit

SYLLABUS

UNIT-I : Basics of Digital Electronics (8 Hours)

Motivation for digital systems: Logic and Boolean algebra, Number Systems. Logic Gates & Truth Tables, Demorgan's law, Minimization of combinational circuits using Karnaugh maps up to five variables. Map manipulation-essential prime implicants, non-essential prime implicants**.**

UNIT-II : Combinational Circuit Design (8 Hours)

Design procedure: Multiplexers, Demultiplexer, Encoders, Decoders, Code Converters, Adders, Subtractor (Half, Full), BCD Adder/ Subtractor, ripple and carry look-ahead addition booth's Algorithm, bit-pair recoding, Integer Division- restoring and non-restoring division

UNIT-III : Sequential circuit Design-I (8 Hours)

Storage elements, Flip-flops and latches: D, T, J/K, S/R flip-flops. Master Slave Conversion of one of type of F/F to another Sequential circuit. Analysis –Input equations, state table,

and analysis with J-K Flip flops. Sequential circuit Design, Design procedure, designing with D & J-K Flip flop.

UNIT-IV : Sequential circuit Design-II (7 Hours)

Counters, asynchronous and synchronous design using state and excitation tables. Registers & Shift registers., Mealey & Moore Machines

UNIT-V : Memory & Programmable logic Devices (8 Hours)

Semiconductor RAM memories, Static and Dynamic Memories, ROM, higher order memory design, multi-module memories, Memory interleaving, , Secondary storage – Magnetic disk, Optical disk, PLA, PAL.

Text Books

1. Morris Mano; Digital Logic Design; Fourth edition, McGraw Hill
2. R.P .Jain; Modern Digital Electronic; Fourth edition; Tata McGraw-Hill.
3. V.J.Vibhute; 8-Bit Microprocessor & Microcontrollers; fifth edition.

Reference books

1. A. Anand Kumar; Fundamental of Digital Electronics; Second Edition, PHI
2. A.P. Godse; Digital circuit & design; Technical Publications; 2009.
3. Ramesh Gaonkar; 8 bit Microprocessor; CBS Publishers; 2011.

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence I Semester			
Course Title	**Digital Circuits & Logic Design Lab**	**Course Code**	**BAI1P03**
Teaching Hours / Week	**02 P**	**Total Credits:**	**01**
CIE	**25 Marks**	**SEE**	**25 Marks**

Course Outcome	
1	Use logic gates for designing digital circuits
2	Implement combinational circuits
3	Implement sequential circuits
4	Apply the knowledge gained for their project work based on the hardware digital circuits
Practical based on above theory syllabus	

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech.Artificial Intelligence I Semester			
Course Title	**Programming for Problem Solving**	**Course Code**	**BAI1T04**
Teaching Hours / Week	**03 Th**	**Total Credits:**	**03**
CIE	**30 Marks**	**SEE**	**70 Marks**

Course Objectives	
1	To learn the fundamentals of Problem Solving
2	To understand the various steps in program development and learn the syntax and semantics of C programming language
3	To understated and formulate and implement programs to illustrate the applications of different elements such as arrays, pointers, functions and files

Course Outcomes	
On successful completion of course student will learn:	
1	Create C programs using loops and decision-making statements to solve and execute the given problem.
2	Develop programs and functions one dimensional and two-dimensional arrays.
3	Apply the concept of pointers, structures to develop programs.
4	Implement files in C to store the data for the given problem
5	Explain significance of pointers and Develop c programs using structures and Pointers

UNIT-I : Introduction to Programming **(8 Hours)**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart /Pseudo code with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language **(8 Hours)**

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Pre-processor Directives, Decision Control Statement-if, if-else, nested if-else

statement, switch case,Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms (8 Hours)

Arrays: 1-D, 2-D, Character arrays and Strings. Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (noformal definition required)

UNIT-IV: Functions and Recursion (8 Hours)

User defined and Library Functions, Parameter passing in functions, call by value, passing arrays tofunctions: idea of call by reference. Recursion: As a different way of solving problems. Exampleprograms, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures (8 Hours)

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writingthe file, Closing the files, using fflush ().

Text Books:

1. Programming in ANSI C: E. Balguruswami McGraw Hill
2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence I Semester			
Course Title	**Programming for Problem Solving Lab**	**Course Code**	**BAI1P04**
Teaching Hours / Week	**02 P**	**Total Credits:**	**01**
CIE	**30 Marks**	**SEE**	**70 Marks**

Course Outcomes
On successful completion of course student will be able to:
1. Create C programs using loops and decision making statements to solve and execute the givenproblem.
2. Develop programs and functions one dimensional and two dimensional arrays.
3. Apply the concept of pointers, structures to develop programs.
4. Implement files in C to store the data for the given problem.

Practical based on above theory syllabus

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence I Semester			
Course Title	**Vocational Course- on UI/UX**	**Course Code**	**BVS1P01**
Teaching Hours / Week	**04 P**	**Total Credits:**	**02**
CIE	**50 Marks**	**SEE**	**50 Marks**

Course Objectives :	
1	Understand the definition and principles of UI/UX in order to design with intention.
2	Learn the basics of HCI (human-computer interaction) and the psychology behind user decision-making.
3	Explore UI/UX tools to interpret requirements of modern applications.
Course Outcomes :	
CO1	Understand basics of UI/UX
CO2	Design and develop web pages using HTML, CSS and JavaScript
CO3	Infer the significance of Wire framing and build prototypes.

Unit 1 : UI/UX Overview (7 Hours)

Introduction to UI/UX, Principles of UI/UX, UI Components, Design Thinking,Interaction Design, Usability.

Unit 2 : UI Programming (8 Hours)

Basic of HTML5, Elements of HTML5, Background of CSS, Bootstrap CSS,Fundamentals of JavaScript, HTML DOM Manipulations.

Unit 3 : UX Programming (7 Hours)

Figma Basics, How to identify user needs, Wireframe and Prototype, DigitalStorytelling.

Text Books

1. UI/UX design for designer and developers: by Nathan Clark
2. Web Design: A Beginner's Guide Second Edition by Wendy Willard
3. User story mapping by Jeff Patton, O'Reilly Publication

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

I Semester

Course Title	Communication Skills	Course Code	BAE1T01
Teaching Hours / Week	01 T	Total Credits:	01
CIE	15 Marks	SEE	35 Marks

Prerequisites : Basic knowledge of Communication Skills

Course Objectives :

1	Students would be able to enhance their communication skills.

Course Outcomes :

On completion of the course, students will be able to-

CO1	Construct grammatically correct sentences.
CO2	Identify and overcome barriers of communication.
CO3	Demonstrate good Listening and speaking skills.
CO4	Develop effective reading and writing skills.

Unit I : Grammar [4 Hours]

Tenses and its types, sentences and its Types, Transformation of Sentences (Assertive, Affirmative, Negative, Interrogative, Exclamatory) Reported speech

Unit II : Communication [3 Hours]

Introduction to Communication, Importance of communication Types of communication- Verbal and non-verbal Communications: - Kinesics, Vocalics, Chronemics, Haptics, Proxemics. Barriers to communication and methods to overcome them.

Unit III : Skills [4 Hours]

Introduction to LSRW Skills-, Listening Skills: Importance of listening, Types of listening, listening barriers and methods to overcome, Speaking Skills: Components of public speaking, Essential steps for public speaking, Overcoming stage fear in public speaking, Do's, and Don'ts of Public speaking

Unit IV : Reading & Writing [3 Hours]

Reading Skills: Importance of reading skills, Types of reading, comprehending passages, Writing Skills: Importance of effective writing, Paragraph writing, Email etiquettes.

Reference books :

1. Technical Communication by Meenakshi Raman and Sangeeta Sharma, OUP
2. Public Speaking and Influencing Men in Business by Dale Carnegie
3. Professional Communication Skills by Bhatia and Sheikh, S. Chand Publications
4. Communication Skills by Sanjeev Kumar and Pushpalata, OUP
5. Communication Skills by Lalita Bisen, Bhumika Agrawal, N. Thejo Kalyani, Himalaya Publishing House

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

I Semester

Course Title	Communication Skills LAB	Course Code	BAE1P01
Teaching Hours / Week	02 P	Total Credits:	01
CIE	15 Marks	SEE	35 Marks

Sr. No.	List of Experiments
1	Barriers to Communication
2	Non-verbal Communication
3	Listening Skills
4	Reading Skills
5	Speaking Skills
6	Presentation Skills
7	Group Discussion
8	Interview Techniques

Beyond/Additional Syllabus Experiments	
1	Development of Word Power
2	Use of Figurative language

Suggested Textbooks/Reference Books/ Web page (URL)/Research paper, etc.

1. Technical Communication by Meenakshi Raman and Sangeeta Sharma, OUP
2. Public Speaking and Influencing Men in Business by Dale Carnegie
3. Professional Communication Skills by Bhatia and Sheikh, S. Chand Publications
4. Communication Skills by Lalita Bisen, Bhumika Agrawal, N.Thejo Kalyani, Himalaya

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

Scheme of Teaching & Examination of Bachelor of Technology

II Semester B.Tech. (Artificial Intelligence)

Sr. No.	Category	CourseCode	Course Name	Concern BOS	Hours / Week			Credits	Examination Scheme						
									Theory				Practical		
					L	T	P		Exam Hours	SEE	CIE	Min	SEE	CIE	Min
1	BSC-III	BAI2T05	Essentials of Physics	ASH	3	0	0	3	3	70	30	45	-	-	-
2	BSC-III	BAI2P05	Essentials of Physics Lab	ASH	0	0	2	1	-	-	-	-	25	25	25
3	BSC-IV	BAI2T06	Discrete Mathematics	ASH	3	1	0	4	3	70	30	45	-	-	-
4	ESC – III	BAI2T07	Object Oriented Programming	ET in E&T	3	0	0	3	3	70	30	45	-	-	-
5	ESC – III	BAI2P07	Object Oriented Programming Lab	ET in E&T	0	0	2	1	-	-	-	-	-	50	25
6	PCC-I	BAI2T08	Computer Architecture	ET in E&T	2	0	0	2	3	70	30	45	-	-	-
7	SEC-I	BSE2P01	Refer SEC Basket	ET in E&T	0	0	4	2	-	-	-	-	50	50	50
8	IKS– I	BIK2T01	Refer IKS Basket	ASH	2	0	0	2	3	70	30	45	-	-	-
9	CC – II	BCC2P02	Refer CC Basket	ASH	0	0	4	2	-	-	-	-	-	100	50
Total					**13**	**1**	**12**	**20**	-	**350**	**150**	-	**100**	**225**	-

Exit option: Award of UG Certificate in Major with 40 credits and an additional 8 credits in skill-based courses, internship, mini projects etc.

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	Essential of Physics	Course Code	BAI2T05
Teaching Hours / Week	03 L	Total Credits:	03
CIE	30 Marks	SEE	70 Marks

Course Objectives:	
1	To introduce ideas of quantum mechanics necessary to understand the function of quantum computing
2	To gain an understanding of the total internal reflection in optical communication system
Course Outcomes: After successful completion of the course, the students will be able to -	
CO1	Learn the basic concepts of the dual nature of matter, differentiate between bits and qubits, and apply them to analyze various relevant phenomena in Quantum Computers and solve related numerical problems.
CO2	Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering
CO3	Identify and explain different types of diodes, transistors, and their applications
CO4	Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications in electron optic devices and CRO
CO5	Learn and explain nanoscience and its properties related to bulk materials

Syllabus	

UNIT I : Quantum Computing (7 hours)

Introduction to bits and qubits.Difference in bits and qubits. Quantum entanglement, Brief introduction about quantum computers Concept of wave-particle duality, De-Broglie Hypothesis, Matter Waves, Davisson-Germer Experiment, Concept of wave packets, Heisenberg Uncertainty Principle. Schrodinger wave equation (time dependent and time independent), Wave function Ψ, probability function, normalization condition, Eigen values, eigen function, Application to one dimensional infinite potential well.

Unit 2: Optical fiber(7 Hours)

Structure of optical fiber, total internal reflection, modes of propagation, Graded index profile, Numerical aperture, classification of optical fiber, Acceptance angle and cone , attenuation and dispersion, fiberoptic communication system .

Unit 3: Semiconductor Physics (7 Hours)

Classification of materials on the basis of band gap, conductivity, drift and diffusion current intrinsic and extrinsic semiconductors. Diode and types of diodes: PN junction, Zener diode, LED, Tunnel diode, Photo diode, transistors, common base, common emitter configurations.

Unit 4: Electron Optics (8 Hour)

Motion of electron in magnetic and electric field, Bethe's law, Electrostatic lens, Block diagram and functions of each part of CRT and CRO, trigger circuit, time base circuit applications of CRO.

Unit 5: Nanotechnology (7 Hours)

Concept of nanotechnology, Top-down and bottom-up approach, comparison of properties of bulk and nanomaterials, sol gel and ball mill process, special types of materials, Zeolite and Graphene, applications of nanotechnology.

Reference Books

1. P. M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata McGraw Hill (1977).
2. J. L. Powell and B. Crasemann, Quantum Mechanics, Narosa Publishing House (1993).
3. Charles Kittel, Introduction to Solid State Physics, Wiley Eastern, 5th edition, (1983).
4. A. J. Dekker, Solid State Physics, Prentice Hall of India (1971).
5. A Textbook of Engineering Physics, Dr. M. N. Avdhanulu, Dr. P. G. Kshirsagar, S. Chand Publication
6. Text book of Applied Physics, Dr. D. S. Hardas, Dr. D. S. Bhoumik, Dr.S. Shastri, Das Ganu Publication ISBN-978-93-84336-59-2 (2021)
7. Applied Physics, M. N. Avdhanulu, Shilpa A. Pande, Arti R. Golhar, Mohan Giriya, S. CHAND
8. A Text Book of Engineering Physics Dr. DevashreeHardas& Dr. AshishPanat, Das Ganu Publication ISBN-978-81-921757-7-5 (2011)
9. Applied Physics, - Dr. (Mrs)S.P. Wankhede, Dr.ShrutiPatle, Dr.(Mrs.)S.U.Bhonsule and Dr.N. S. Ugemuge DNA Publication ISBN-978-81-945174-6-7 (2020)
10. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles by R. Eisberg and R. Resnick, Wiley and Sons
11. Engineering Physics, second edition, Sanjay Jain, G. Sahasrabudhe, University's Press(India) Pvt. Ltd.(2016)
12. D. J. Griffiths, Quantum mechanics, Prentice Hall of India Private Limited, New Delhi
13. L. I. Schiff, Quantum Mechanics, TMH Publications
14. Advanced Engineering Materials - Dr. Sangeeta G. Itankar, Dr. ManjushaDandekar, Dr. Tushar R. Shelke, Dr. Swati Fartode, Alliance & Co. ISBN 978-93-91322-12-0 (2023)
15. Applied Physics- Dr. Sangeeta G. Itankar, Dr. ManjushaDandekar, Dr. Tushar R. Shelke, Dr. Swati Fartode, Alliance &Co. ISBN 978-93-91322-97-7 (2023)
16. David Halliday, Robert Resnick, Jearl Walker, Principles of Physics, 10^{th} Edition, John Wiley and Sons (2017)
17. Advanced physics - Dr.ShrutiPatle, Dr.(Mrs).S.U.Bhonsule, Dr.Ashish N. Bodhaye, Dr.ManoharD.Mehare DNA Publication (2019)
18. Engineering Physics - Dr.N. S. Ugemuge, Dr.(Mrs.)S.U.Bhonsule and Dr.ShrutiPatle DNA Publication(2019)

Rashtrasant Tukdoji Maharaj Nagpur University
B.Tech. Artificial Intelligence
II Semester

Course Title	Essential of Physics Lab	Course Code	BAI2P05
Teaching Hours / Week	02 P	Total Credits:	01
CIE	25 Marks	SEE	25 Marks

Course Objectives:

1	The physics laboratory will consist of experiments and programmingexercises illustrating the principles of quantum physics and quantumcomputing relevant to the study of computer science and engineering.

Course Outcomes: After successful completion of the course, the students will be able to -

CO1	Develop skills required for experimentation and verification of physics laws.
CO2	Utilize Mathematica software for graph plotting and for least squares fittingof the experimental data.
CO3	Use of basic physics laws in electronics and computer Science.
CO4	Apply the virtual lab to solve eigenvalues and eigenfunctions.
CO5	Understand the fundamental electronics.

List of Experiments: (Any Six)

1. Introduction to quantum computers.
2. Energy gap of semiconductor /thermistor.
3. Parameter extraction from V-I characteristics of PN junction diode.
4. Parameter extraction from V-I characteristics of Zener diode.
5. Parameter extraction from V-I characteristics of PNP/NPN transistor in CB and CE mode.
6. V-I Characteristics of Tunnel diode.
7. V-I Characteristics of Light Emitting Diodes/ Determination of Plank's constant by using LEDs.
8. Study of Diode rectification.
9. Study of Hall Effect and determination of Hall Voltage of given sample.
10. Variation of Hall coefficient (R_H) with temperature.
11. To study B-H curve and to find out the values of coercivity, retentivity and saturation magnetization of experimental material.
12. Determination of NA for optical fiber
13. Calibration of Time Base circuit of CRO and determination of AC , DC voltage & frequency of electrical signals using CRO.
14. To determine the number of lines per cm on a diffraction grating using LASER beam.
15. Virtual Lab: Experiment on the determination of the thickness of a thin foil using an air wedge arrangement.
16. Virtual Lab: Experiment on the determination of the refractive indices of the material corresponding to ordinary and extra - ordinary rays

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	Discrete Mathematics	Course Code	BAI2T06
Teaching Hours / Week	03 L + 01 T	Total Credits:	04
CIE	30 Marks	SEE	70 Marks

Course Objectives :

1	The objective of this course is to expose student to understand the basic importance of Logic, Number theory, Algebraic structures like groups and Field, combinatory and graph theory in computer science and Information technology.

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Formulate problems and solve recurrence relation
CO2	Apply techniques of number theory to solve problems from linear congruence's, coding theory etc.in cryptography.
CO3	Internalize logical notations to define and reason about fundamental mathematical concepts anduse it derive logical inference.
CO4	Apply groups and fields in coding theory.
CO5	Understand the Lattice as algebraic structure and use it for pattern recognition and incryptography.

Syllabus

Unit 1: **(9 Hours)**

Combinatorics: Addition and multiplication rule in combinatorics, Linear and Circular permutation, Combination, Binomial Identities, Inclusion and Exclusion Principle, distribution Principle, recurrence relations, generating function, examples using ordinary power series and exponential generating functions.

Uni 2: **(8 Hours)**

Modular Arithmetic: Modular Arithmetic, Euclid's Algorithm, primes, Fermat's theorem, Euler's theorem, Diophantine equations, Linear congruence's, Chinese Remainder theorem, application to Cryptography.

Unit 3: **(7 Hours)**

Mathematical Logic: Statement and notations, connectives, Negation, conjunction, disjunction, conditional & bi-conditional statement. Tautologies, equivalence of formulas, Duality law, Tautological implications, Theory of inference for statement calculus.

Unit 4: **(9 Hours)**

Groups and Fields: Group definitions and examples, cyclic group, permutation groups, subgroups and homomorphism, co-sets, Lagrange's theorem and Normal subgroup, Error correcting codes, Hamming codes. Finite field, Galois field.

Unit 5: **(7 Hours)**

Lattice theory: Lattices as partially ordered set, Properties of Lattice, Lattices as algebraic system, sub lattices, direct product, homomorphism, some special Lattices.

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science: J. P. Tremblay and R. Manohar, Tata McGraw-hill.
2. Discrete Mathematics: Babu Ram, Pearson Publication.
3. Combinatorial Mathematics: C. L. Liu & D. P. Mohapatra, 3rd edition, Tata McGraw-hill.
4. David M Burton, 'Elementary Number Theory', McGraw Hill, Seventh edition 2014.

Reference Books:

1. Foundations of Discrete Mathematics: K. D. Joshi, New age international Publication.
2. Discrete Mathematics: Kolman, Busby & Ross, Pearson Publication.

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence II Semester			
Course Title	**Object Oriented Programming**	**Course Code**	**BAI2T07**
Teaching Hours / Week	**03 L**	**Total Credits:**	**03**
CIE	**30 Marks**	**SEE**	**70 Marks**

Course Objectives :	
1	To make students understand Fundamental features of an object oriented language like Java: objectclasses and interfaces, exceptions and libraries of object collections
2	Introduce students with fundamental concepts like exception handling, generics, collection classesand streams.

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Understand the object-oriented programming features, classes, objects and methods
CO2	Develop efficient programs by implementing the concept of Inheritance, polymorphism exceptionhandling.
CO3	Use the concept of generics, collections, streams to develop solution to the given problem.
CO4	Analyze characteristics and need of design pattern in software design process.
CO5	Understand the Lattice as algebraic structure and use it for pattern recognition and incryptography.

Syllabus

Unit 1: **(9 Hours)**

Features of Object-Oriented Programming languages, Abstraction, Encapsulation, Inheritance,polymorphism and late binding. Programming paradigms, Bytecode, JDK, JRE, JVM.

Concept of a class and object, ways of representing objects, access control of

members of a class,instantiating a class, constructor.

Unit II: (8 Hours)

Concept of overloading: Constructor Overloading, Function Overloading.

Arrays and Array of objects, Wrapper classes (Integer, Double etc.), String Class, creating packages,importing packages.

Lambda Expressions Introduction, Block, Passing Lambda expression as Argument

Unit III: (8 Hours)

Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism, abstract classes and methods, Interface, implementation of interface, static and non-static members.

Unit IV: (9 Hours)

Exceptions, types of exception, use of try catch block, handling multiple exceptions, using finally, throw and throws clause, user defined exceptions, Introduction to streams, byte streams, character streams, file handling in Java, Serialization.

Unit VI: (8 Hours)

Introduction to Design Patterns, Need of Design Pattern, Classification of Design Patterns, Role of Design Pattern in Software design, Creational Patterns, Structural Design Patterns and Behavioral Patterns.

Text Books

1. Herbert Schildt; JAVA The Complete Reference; Ninth Edition, Tata McGraw- Hill PublishingCompany Limited.
2. Design Patterns By Erich Gamma, Pearson Education

Reference Books

1. Paul Deitel, Harvey Deitel; Java 9 for Programmers; Pearson
2. Herbert Schildt and Dale Skrien; Java Fundamentals A Comprehensive Introduction; TataMcGraw- Hill Education Private Ltd 2013.

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	Object Oriented Programming Lab	Course Code	BAI2P07
Teaching Hours / Week	02 P	Total Credits:	01
CIE	25 Marks	SEE	25 Marks

Course Objectives :

1	To develop ability of students to implement basic concepts and techniques of object orientedprogramming paradigm like encapsulation, inheritance, polymorphism, exception handling.
2	Develop solution to problems using collection classes, generics, streams, multithreading.

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Develop the solutions using basic features of Object-Oriented Programming.
CO2	Design efficient and reusable solutions using inheritance and exception handling techniques.
CO3	Create and use type-safe object through generics and collection classes

Syllabus

Experiments based on above Syllabus.

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	Computer Architecture	Course Code	BAI2T08
Teaching Hours / Week	02 L	Total Credits:	02
CIE	30 Marks	SEE	70 Marks

Course Objectives :

The objective of this course is to familiarize the prospective engineers with:

1	Concepts of computer architecture by developing understanding of various functional units,components of computers and working of all the modules.
2	Design principles of modern computers including memory, bus system, input/output operation,interrupt handling mechanism and parallelization.

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Demonstrate the understanding about the functional units of a digital computer system.
CO2	Execute complete instruction on different types of bus architectures with control signalgeneration.
CO3	Analyse memory, multiprocessor and multicore architectures and their implications in parallelcomputing.

Syllabus

UNIT I : Basic Structure of Computer (6 Hours)

Functional units of computer, basic operational concepts- Instruction, processor and memory, operating steps, address, Big- and Little-endian assignments, Instructions set architecture of a CPU- Instruction Formats, Instruction sequencing, addressing modes, and instruction set classification, subroutine & parameter passing, expanding opcode, RISC and CISC.

UNIT II : Basic Processing Unit and Data Representation (6 Hours)

Basic Concepts- Instruction execution, Bus architecture- One bus and Multi-bus, Execution of a Complete Instruction, sequencing of control signals, Hardwired control, Micro-programmed Control. Floating point numbers-representation, guard bits and rounding.

UNIT III : Memory & Input/output (7Hours)

Cache memory, Cache size vs. block size, mapping functions, replacement algorithms, Cache read/write policy, Virtual Memory, I/O mapped I/O and memories mapped I/O, interrupt and interrupt handling mechanisms, vectored interrupts, synchronous vs. asynchronous data transfer, Bus Arbitration, Direct Memory Access

UNIT IV : Pipelining (7 Hours)

Basic concepts of pipelining, throughput and speedup, Introduction of Parallel Computing: SISD, MISD, SIMD, MIMD

Text Books

1. V.C.Hamacher, Z.G.Vranesic and S.G.Zaky; Computer Organisation; 5th edition; Tata McGrawHill, 2002.
2. W. Stallings; Computer Organization & Architecture; PHI publication; 2001.
3. J. P. Hayes; Computer Architecture & Organization; 3rd edition; McGraw-Hill; 1998.

Reference Books

1. M Mano; Computer System and Architecture; PHI publication; 1993.
2. A. S. Tanenbaum; Structured Computer Organization; Prentice Hall of India Ltd.

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	React JS Web Development	Course Code	BSE2P01
Teaching Hours / Week	04 P	Total Credits:	02
CIE	50 Marks	SEE	50 Marks

Course Objectives :

The objective of this course is to familiarize the prospective engineers with:

1	The objective of this course is to familiarize the students with an important web framework for developing user interfaces. It aims for developing high end web applications by the use of ReactJS features.

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Understanding the fundamentals of ReactJS including components, props, state, and life cycle methods.
CO2	Design and implement complex applications by composing smaller, reusable componentstogether.
CO3	Building Web Applications to create dynamic and interactive web applications using React andother related technologies like JSX and ES6.
CO4	Implement React Router to handle client-side routing and create single-page applications.

Syllabus

UNIT-I **(7 Hours)**

Introduction to React

React JS Introduction, Advantages of React JS, Introduction to JSX, Difference between JS

and JSX.

UNIT-II **(8 Hours)**

Components in React

React Components overview, Types of components, Controlled, Split Up, Composable, Reusable,Component Declarations and Styling Components

State and it significance, Read state and set state, Passing data to component using props, Validatingprops using prop Types, Supplying default values to props using default Props

UNIT-III **(7 Hours)**

Routing with react router

Introduction to React Router, Routing in single page applications, Browser Router and Hash Router components Configuring route with Route component.

Text Books

1. Pure React- a step by step guide - Dave Ceddia
2. Road to learn react - Robin Wieruch
3. React in Action 1st Edition - Mark Tielens Thomas

Rashtrasant Tukdoji Maharaj Nagpur University B.Tech. Artificial Intelligence II Semester			
Course Title	**Skill enhancement Course -1 (Web Technology)**	**Course Code**	**BSE2P01**
Teaching Hours / Week	**04 P**	**Total Credits:**	**02**
CIE	**50 M**	**SEE**	**50 Marks**

Course Objectives :

The objective of this course is to familiarize the prospective engineers with:

1	To know the basics of server side scripting using PHP

Course Outcomes :

After successful completion of the course, the students will be able to -

CO1	Create web pages using PHP
CO2	Identify the difference between the HTML PHP and XML documents.
CO3	Create web pages using PHP with MySql

Syllabus

UNIT-I **(7 Hours)**

Introduction to PHP:, Declaring variables, data types, arrays, strings, operations, expressions, control structures, functions, Reading data from web form controls like Text Boxes, radio buttons, lists etc.,

Unit 2 **(7 Hours)**

Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2

Unit 3 **(7 Hours)**

Basic command with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs

Text Books

1. The Joy of PHP : Alan Forbes
2. **PHP and MySQL Web Development :** Luke Welling
3. **Learning Php : Robin Nixon**

Rashtrasant Tukdoji Maharaj Nagpur University

B.Tech. Artificial Intelligence

II Semester

Course Title	Consciousness Studies (IKS)	Course Code	BIK2T01
Teaching Hours / Week	02 T	Total Credits:	02
CIE	30	SEE	70Marks

Course Outcomes

After the completion of Course, Students will be able to

1	Analyze the basics of Psychology and its applications
2	Develop knowledge about the sensory processes and perception
3	Apply various theories of classical conditioning
4	integrate the theories of memory and behaviour of mind

Syllabus

Unit 1 **(7 Hours)**

An introduction to Psychology Introduction to Psychology, Definition of psychology, history, methods in Psychology, Subfields of Psychology and its applications

Unit 2 **(7 Hours)**

Basic Cognitive Processes Sensory processes-general characteristics of senses, visual sense, auditory sense, other senses Perceptual organization-principles of perceptual organization, object perception and perceptual constancies, influences upon perception, extrasensory perception

Unit 3 **(7 Hours)**

Classical conditioning, theories about classical conditioning, Reinforcement and Punishment

Unit 4 **(7 Hours)**

Theories about memory, brain and memory, long term memory, forgetting

Reference Books:

1. Clifford T. Morgan, King, Weisz and Schopler, Introduction to Psychology, McGraw Hill Education (India) Private Limited
2. Hilgard, Atkinson and Atkinson(1977). Introduction to Psychology. Tata McGraw Hill
3. Kao H.S R.& Sinha D. (Eds)(1977). Asian perspectives on psychology. New Delhi: Sage

Course Title	Preserving Art, Culture and Tradition (IKS)	Course Code	BIK2T01
Teaching Hours / Week	02 T	Total Credits:	02
CIE	30	SEE	70Marks

Course Objectives :

1	To provide overview of Indian Knowledge System (IKS) and sensitize the students to the contributions made by Indians in the field of philosophy, art and health.

Course Outcomes :

On completion of the course, students will be able to-

CO1	Interpret basics of Indian Knowledge system.
CO2	Integrate the teaching of Indian culture and civilization
CO3	Appreciate Indian artistic tradition.
CO4	Analyze Indian health and wellness system for healthy living

Syllabus

Unit 1 **(8 Hours)**

Introduction to Indian Knowledge System Introduction and overview of Indian Knowledge system, The Vedic Corpus -Vedas, Types of Vedas, Upavedas, Types of Upavedas

Unit 2 **(8 Hours)**

Indian Culture and Civilization Indian culture and Civilization: its characteristics, Difference between Culture and Civilization, Indus valley civilization, Vedic civilization.

Unit 3 **(8 Hours)**

Indian Artistic Tradition, Indian Artistic tradition: Chitrakala- Indian style painting (Madhubani, Warli, Phad, Kalamkari, Gond, Mandana), Nritya : Indian dance forms (Bharatnatyam, Kathak, Kathakali, Kuchipudi, Manipuri, Mohiniattyam) Sangeet-Carnatic music & Hindustani music

Unit 4 **(8 Hours)**

Health and Wellness

Health and Wellness, Well being: Mental & Physical, Dimensions of Wellness, Concept of

healthy living in Ayurveda, Tri-doshas –Relationship to Health
Activity: Prepare PPTs/Posters/Videos on any two topics
Books Recommended: 1. Introduction to Indian Knowledge System by Mahadevan, B, Bhat, Vinayak Rajat, Nagendra Pavana R.N., Prentice Hall India Pvt., Limited, 2022. 2. Indian knowledge Systems, Kapil Kapoor, Avadhesh Kumar Singh, D.K, Printworld. 3. Traditional Knowledge System in India by Amit Jha, Atlantic Publishers, 2002 4. Exploring The Mysterious, By T.N. Dhar · Mittal Publications, 2004 5. Indian Art & Culture (E), By Anurag Kumar, Arihant Publication India Limited, 2016 6. A History of Indian Philosophy, Volume 2, By Surendranath Dasgupta, Diamond Publishers, 2017 7. Sri Suresh Soni, Sources of our cultural heritage, Prabhat Prakashan, 2018. 8. A Beautiful Tree by Dharampal, Rashtrotthana Sahitya, 2021

Course Title	Glimpses of ancient Science and Technology (IKS)	Course Code	BIK2T01
Teaching Hours / Week	02 T	Total Credits:	02
CIE	30	SEE	70Marks

Course Objectives:

1	To provide the students with scientific foundation of Ancient Indian Knowledge System
2	To create awareness about scientific heritage of the ancient civilization Course Outcomes

Course Outcomes :

On completion of the course, students will be able to-

	After successful completion of this course the student will be able to
CO1	To provide information about great mathematicians and to help students to trace, identify, practice, and develop the significant Indian mathematics
CO2	To understand the concept of motion and its application in Indian ancient physics literature.
CO3	To understand the concepts of basic chemical & metallurgical process of ancient and medieval India.

Syllabus

Unit 1 **(8 Hours)**

Mathematics in India: Introduction of inception of Mathematics from vedic periods. Great Mathematician and their contribution (e.g. Arytabhatta, Bhaskara, Brahmagupta, Ramanujan, Pingala, Bhaskara-II), Sulbhasutras (Pythagoras theorem), Square, Square root, Square root of imperfect Squares, Magic Squares, Value of Pi.

Unit 2 **(8 Hours)**

Physics in India: Vaisheshikadarshan Atomic theory & law of motion, theory of Panchmahabhoota, BrihathShathaka (divisions of the time, unit of distance), Bhaskarachaya (Introduction to theory of Gravity, Suryasiddhanta &Sidhantashriomani), Lilavati (Gurutvakashan Shakti).

Unit 3 **(8 Hours)**

Chemistry in India:Vatsyayana, Nagarjuna, Vagbhaṭa –building of Theras-Shala (laboratory), working arrangements of Ras-Shala, material and equipment,YaśodharaBhaṭṭa-process of distillation, apparatus. Metallurgy in India: Survarṇa(gold) and its different types, properties, Rajata(silver), Tamra(copper), Loha(iron), Jasta(zinc), Naga /Sisa(lead), Pittala(brass).

Text Books Recommended

1. R P Kulkarni, Glimpses of Indian Engineering and Technology (Ancient & Medieval period, MunshiramManoharlal Publishers Pvt. Ltd. 2018
2. AK Pathak, Science and Technology in India, Anshikaprakashanpratapgarh, 2016
3. PB Sharma, S. Narain, Doctors Scientists and Engineers of Ancient India, Kalpaz Publications 2017
4. NVP, Unithiri, Indian Scientific Traditions (Professor K.N. NeelakantanElayath Felicitation Volume), publication division university of Calicut, 2006
5. Anonyms, History of Science in India- Volume-I Part-I (Physics, Mathematics and Statistics), the national academy of science, India & the Ramkrishna mission institute of culture, 2014

Reference Books Recommended

1. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of Sankaracharya, Central Chinmay Mission Trust, Bombay, 1995
2. Dharmpal, Indian Science and Technology in the eighteen century, Rashtrottahanasahitya, 1983
3. S Biswal, B L Ray, Vedic Science and technology, DK Print world, 2009
4. A.K Bag, History of technology in Indian (Set 3 vol), Indian Nation Science Academy, 1997.
5. A Gosh, History of Science in India (Volume-I Part-II Astronomy), the national academy of science, India & the Ramkrishna mission institute of culture, 2014