Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
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शिवाजी विद्यापीठ, कोल्हापूर
४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
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SU/BOS/Sci & Tech/ 445 **Date: 01/08/2024**

To,

The Director,
Departments of Technology,
Shivaji University, Kolhapur.

Subject: Regarding New syllabus of **B. Tech. Programme (Department of Technology)** Part - II (Sem-III-IV) under the Faculty of Science and Technology as per National Education Policy 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabus B. Tech. Part - II (Sem - III & IV) under the Faculty of Science & Technology as per National Education Policy 2020.

As per NEP 2020 **B. Tech (Deparment of Technolgy) Syllabus -2024-25**		
No.	**BOS/Ad-hoc Board**	**Course Syllabus**
1	Civil Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Civil Engineering
2	Mechanical Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Mechanical Engineering
3	Computer Science Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Computer Science and Technology
4	Chemistry & Chemical Engineering	B.Tech. Part-II, (Sem- III – IV) Chemcial Engineering
5	Electronics Sciences, Electronics Engineering and Technology	B.Tech. Part-II, (Sem- III – IV) Electronics and Telecommunication Engineering
6	Food Science and Technology	B.Tech. Part-II, (Sem- III – IV) Food Technolgy

B. Tech First Year (Sem – I & II) all Branches syllabus and Rules, Regulation, Guidelines, Structure and equivalence shall be implemented from the academic year 2023- 2024 onwards. A soft copy containing syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in. (Student Online Syllabus).**

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Copy to:

1	The I/c Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	The Chairpersan, Respective Board of Studies	7	Affiliation Section (T.1) (T.2)
3	OE 4	8	P.G.Admission Section, P.G Seminar Section
4	Eligibility Section,	9	Computer Centre

Shivaji University

Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Second Year B.Tech (Computer Science and Technology) Detailed Curriculum 2024-25 onwards

A. Component wise distribution of credits

(Expected range of credits as per AICTE & NEP2020 guidelines is 160-176)

Sr. No.	Category Suggested	Course Code	No. of Credits	Components %
1.	Indian Knowledge System	IKS	05	2.84
2.	Ability Enhancement Course	AEC	03	1.70
3.	Value Education Courses	VEC	02	1.13
4.	Basic Science Courses	BSC	22	12.5
5.	Engineering Science Courses including workshop, drawing, basics of civil/electrical/mechanical/computer etc.	ESC	24	13.63
6.	Professional Core Courses	PCC	75	42.61
7.	Professional Elective Courses relevant to chosen specialization/branch	PEC	12	6.81
8.	Open subjects – Electives from other technical and /or emerging subjects	OEC	06	3.40
9.	Project , Seminar and Internship	PSI	11	6.25
10.	Project Based Learning	PBL	02	1.13
11.	Multidisciplinary Minor	MDM	14	7.95
12.	Vocational and Skill Enhancement Courses	VSEC	Audit Courses	-
13.	Humanities and Social Sciences including Management & Environment Courses	HSMEC		
14	Mandatory Audit Courses [Some other courses Decided at the Institute level but that do not get fit in the credits]	MAC		
	Total		**176**	**100**

B. Engineering Graduate Attributes

1. Domain specific Engineering Knowledge
2. Problem Analysis Ability
3. Acquiring Skills that enable them to Design & Develop Solutions to the Problems
4. Capacity to investigate Complex Problems
5. Familiarity of using Modern Tools

6. Understanding Engineer's role and connectivity towards Society
7. Awareness about Environment & Sustainability
8. Practicing ethics and values
9. Ability to work as an Individual & in a Team also
10. Acquiring Communication skills
11. Becoming well verse with task of Project management & Finance aspects
12. Developing Lifelong Learning attitude

Note: For every program, there are its own Program Educational Objectives (PEOs) while there are 12 Program Outcomes (POs) which are aligned with these graduate attributes for the engineers.

C. B. Tech (Computer Science and Technology) Program: Vision, Mission, PEOs and POs.

VISION:

To be a centre of academic excellence and research in the field of Computer Science and Technology by imparting knowledge to students and facilitating research activities that cater the needs of industries and society.

MISSION:

1. To provide a learning environment that help students to enhance problem solving skills, be successful in their professional career and to prepare students to be lifelong learners by offering theoretical foundation in Computer Science and Technology.
2. To prepare students in developing research, design, entrepreneur skills and employability capabilities.
3. To establish Industry Institute Interaction to make students ready for industrial environment.
4. To educate students about their professional and ethical responsibilities.

Program Educational Objectives (PEOs):	
PEO1	To create graduates with sound learning of basics of Computer Science and Technology who can contribute towards propelling Science and Technology.
PEO2	To create graduates with adequate abilities in Computer Science and Technology who can progress towards becoming developers, researchers and designers to fulfill the necessities of Computer Industries.
PEO3	To develop among students capacity to figure, formulate, analyze and solve real life problems confronted in Software Enterprises.
PEO4	Graduate will exhibit professionalism, ethical attitude, communication ability, collaboration in

	their profession and adapt to current trends by engaging in lifelong learning.
Program Outcomes (POs)	
PO1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and Leader in a team, to manage projects and in multidisciplinary environments.
PO12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Shivaji University, Kolhapur

Department of Technology

Second Year B. Tech (Computer Science and Technology), Semester- III

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Basic Science Course	BSC 211	Applied Mathematics- I	03	-	00	03	03	30:70	50:00
2.	Professional Core Courses	PCC211	Discrete Mathematical Structure	03	-	00	03	03	30:70	00:00
3.	Professional Core Courses	PCC212	Digital System and Microprocessor	03	-	02	05	04	30:70	50:00
4.	Professional Core Courses	PCC213	Data Structures	03	-	04	07	05	30:70	50:50
5.	Professional Core Courses	PCC214	Data Communication and Networking	03	-	02	05	04	30:70	00:50
6.	Ability Enhancement Courses	AEC211	Soft Skills Development	01	-	-	01	01	-	50:00
				-	-	-	-	**20**	**500**	**300**
7.	Project Based Learning	PBL211	Mini Project I	-	01	-	01	IE at Course in charge end		
8.	Humanities, Social Sciences, Management, Environment	HSMEC 211	Environmental Studies	02	-	-	02	University Exam at the Even Semester End		
			Total Hours	**18**	**01**	**08**	**27**	-	-	-

Shivaji University, Kolhapur

Department of Technology

Second Year B. Tech (Computer Science and Technology), Semester- IV

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Basic Science Courses	BSC 221	Applied Mathematics- II	03	-	-	03	03	30:70	00:00
2.	Professional Core Courses	PCC221	Theory of Computation	03	-	-	03	03	30:70	00:00
3.	Professional Core Course	PCC 222	Advanced Microprocessor	03	-	02	05	04	30:70	50:50
4.	Professional Core Course	PCC 223	Computer Organization	03	-	-	03	03	30:70	00:00
5.	Professional Core Course	PCC 224	Software Engineering	03	-	-	03	03	30:70	00:00
6.	Professional Core Course	PCC 225	Linux and Shell Programming Lab	-	-	02	02	01	00:00	50:00
7.	Professional Core Course	PCC 226	Object Oriented Programming Lab	-	-	04	04	02	00:00	50:50
8.	MDM Course	MDM 221	Multidisciplinary Minor Course I*	03	-	-	03	03	30:70	00:00
9.	Indian Knowledge Systems	IKS221	Introduction to Performing Arts	01	-	-	01	01	-	50:00
				-	-	-	-	**23**	**600**	**300**
10.	Mandatory Audit Course	MAC 221	Aptitude Enhancement Course I	-	01	-	01	IE at Course in charge end		
11.	Project Based Learning	PBL221	Mini Project II	-	01	-	01	IE at Course in charge end		
12.	Humanities, Social Sciences, Management Environment	HSMEC 221	Environmental Studies	02	-	-	02	University Exam at the Even Semester End		
			Total Hours	**21**	**02**	**08**	**31**	-	-	-

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester III					
Course Code	BCS211					
Course Category	Basic Sciences Courses					
Course title	**Applied Mathematics – I (Advanced Calculus)**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	**-**	**-**	**03**		**03**
Evaluation Scheme	**ISE**	**ESE**	**IE**	**EE**	**Total**	
	30	**70**	**50**	**00**	**150**	
Pre-requisites(if any)	Basic knowledge of Mathematics					
Course Objectives	The Course is aimed at- 1. Introducing linear differential equations and partial differential equations 2. Explaining Laplace Transform, Inverse Laplace Transform and applications to electric circuit problems 3. Demonstrating Fourier transform and their applications. 4. Explaining mathematical programming and assignment problems. 5. Demonstrating applications to computer engineering.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Solve linear differential equations and apply them on simple electric circuit 2. Solve the problems on partial differential equations. 3. Gain the basic knowledge of Laplace transform and their applicability in solving initial value problems. 4. Understands the new notion of Fourier transform and their usability **5.** Solve engineering problems using Mathematical Programming 6. Analyze and solve engineering problems using Assignment problems.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3													
CO 2	3	3													
CO 3	3	1													
CO 4	3	2													
CO 5	3	3		2											
CO6	3	3	3												

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Linear Differential Equations** Linear Differential Equations with constant coefficients, Homogeneous Linear differential equations, Applications of LDE with constant coefficients to Electrical systems.	7

II	**Partial Differential Equations** First order partial differential equations, solutions of first order linear and non-linear PDEs-Four	6
III	**Laplace Transform** Definitions, Laplace transform of standard functions, Properties & theorems of Laplace transform Inverse Laplace transform and application to solutions of linear differential equations (electric circuit problems).	7
IV	**Fourier Transform** Definition, Properties & theorem, Fourier sine & cosine transform, Inverse Fourier transform, Discrete Fourier transform & its properties, Applications of Fourier transform	7
V	**Mathematical Programming** Linear Optimization problems, Standard and Canonical forms, Basic solutions and feasible solutions, Optimal solutions by simplex method, Big M-method, Relation between Primal and Dual L.P.P., Dual simplex method, Solution of Primal L. P. P. using Dual L. P. P	6
VI	**Assignment Problems** Definition, Balanced and Unbalanced assignment problems, Hungarian method of solving assignment problems. Travelling salesmen problem.	6

Suggested list of Assignments:

1. To find solution of LDE with constant coefficients
2. Examples of Homogeneous LDE
3. Problems on Partial differential equations
4. Examples on Properties of Laplace transform
5. Examples on Inverse Laplace transform
6. Examples on Fourier transform
7. Examples on Simplex and Dual Simplex method
8. Examples on Big M-method
9. Assignment Problems

General Instructions:

1. Students must be encouraged to solve engineering mathematics problems using different software's
2. Each Student has to write at least 6 assignments on entire syllabus.

Text Books

i)	Erwin Kreyszig, "Advanced Engineering Mathematics", Fifth Edition, John Wiley & Sons
ii)	B. S. Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi
iii)	S. D. Sharma, "Operations Research", 11th Edition.

Reference Books

i)	C. R. Wylie, "Advanced Engineering Mathematics", 6th Edition , McGraw Hill Publication, New Delhi
ii)	H. A. Taha, "Operations Research", 8 th Edition, Pearson
iii)	S. S. Sastry, "Engineering Mathematics (Volume-I)", 4 th Edition, Prentice Hall Publication, New Delhi
iv)	H. K. Dass, "Advanced Engineering Mathematics", 2014, S. Chand Publishing.
v)	N. P. Bali, Iyengar "A text book of Engineering Mathematics by", Laxmi Publications (P)Ltd., New Delhi
vi)	M. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition, Pearson Education

Year, Program, Semester	S.Y. B. Tech (Computer Science and Technology) , Part II, Semester III					
Course Code	PCC211					
Course Category	Professional Core Courses					
Course title	**Discrete Mathematical Structure**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics					
Course Objectives	The Course is aimed at- 1. Introducing most of the basic terminologies used in computer science courses and application of ideas to solve practical problems 2. Explaining basic mathematical logic and Set theory 3. Demonstrating relations and functions 4. Extending student's Logical and Mathematical ability to deal with abstraction 5. Exposing to concepts and properties of algebraic structures such as semi groups, monoids and groups 6. Demonstrating core ideas in graph theory					
Course Outcomes	Upon completion of this course, student should be able to – 1. Apply mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving 2. Demonstrate the fundamental concepts related to set theory, relations and functions which are frequently required in advanced courses such as analysis of algorithms. 3. Compare algebraic structures like monoid, semi groups and groups. 4. Learn and summarize the group theory and group codes with applications in communication model. 5. Develop the ability to solve the problems related to algebra, POSETs, lattices, Boolean algebra and their application in computer science. 6. Solve the practical problems using graphs and related discrete structures					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3														
CO 2	2	3													
CO 3				2											
CO 4			2												
CO 5	2	2													
CO6		2				2									

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Mathematical Logic :** Introduction, statements and Notation, Connectives, statement formulas and truth tables, well-formed formulas, Tautologies, Equivalence of formulas, Duality law, Tautological implications, functionally complete sets of connectives, other connectives, Normal & Principle normal forms.	8
II	**Set Theory:** Basic concepts of set theory, types of operations on sets, ordered pairs, Cartesian product, representation of discrete structures, relation, properties of binary relations, matrix and graph representation, partition and covering of set, equivalence relation, composition, POSET and Hasse diagram, Function – types, composition of functions, Inverse function.	9
III	**Algebraic Systems:** Semigroups and Monoids, properties and examples.	3
IV	**Groups:** Definition and examples, subgroups and homomorphism, Group codes, communication model, Generation of codes using checksum, error recovery in group codes.	4
V	**Lattices and Boolean Algebra:** Lattice as POSETs, definition, examples and properties, Lattice as algebraic systems, Special lattices, Boolean algebra definition and examples, Boolean functions, representation and minimization of Boolean functions.	7
VI	**Graph Theory:** Basic concepts of graph theory, Storage representation and manipulation of graphs, Fault detection in combinational switching circuits – Faults in combinational circuits, Notions of Fault detection, Algorithm for fault matrix, PERT and related techniques.	8

Text Books

i)	Discrete mathematical structures with applications to computer science", J. P. Tremblay& R. Manohar, Tata McGraw-Hill Edition, 35th Reprint
ii)	"Elements of Discrete Mathematics", C. L. LIU, Tata McGraw-Hill, 2nd Edition, 2002, ISBN 0- 07-043476-X.

Reference Books

i)	Discrete Mathematics and Its Applications", Kenneth H. Rosen, Tata McGraw-Hill, 5th Edition, 2003, ISBN 0-07-053047-5.
ii)	"Theory and problems in Abstract algebra",Schaums outline series, MGH.
iii)	Discrete Mathematics",Lipschutz, Lipson, Tata McGraw-Hill, 2nd Edition, 1999, ISBN 0-07- 463710--X.
iv)	Graph Theory", V. K. Balakrishnan, TMH (Recommended for Graph) ISBN 0-07-058718-3
v)	"Discrete Mathematical Structures", B. Kolman, R. Busby and S. Ross, Pearson Education, 4th Edition, 2002, ISBN 81-7808-556-9

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester III					
Course Code	PCC212					
Course Category	Professional Core Courses					
Course title	**Digital system and Microprocessor**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	02	05		04
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites(if any)	Basic knowledge of digital logic and computer hardware basics.					
Course Objectives	The Course is aimed at- 1. Introducing the analysis and design of digital systems and microprocessors. 2. Understanding combinatorial analysis and design. 3. Explaining Computer aided design and programming of digital electronic circuits through the application of several modern software packages. 4. Explaining features and architectures of 8085. 5. Introducing 8085 Instruction set. 6. Studying types of Main memory.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the logical behavior of digital circuits 2. Design combinatorial logic using K maps 3. Design sequential logic using ASM charts 4. Analyze combinatorial and sequential digital circuits 5. Explain the architecture, pin configuration of various microprocessors 6. Perform various microprocessor-based programs and apply the concepts of 8085 programming, interrupts, stacks & subroutines					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1		2								2				
CO 2			2	2	2										
CO 3			1		2										
CO 4		3					2								
CO 5		1									1				
CO6					1						3				

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Fundamentals Concepts:** Logic Families, TTL, TTL sub families, Characteristics of TTL gates, Axioms and laws of Boolean algebra, Practical examples with logic gates IC's.	3
II	**Combinatorial Logic Design:** Boolean algebra, min and max terms, K-maps and quine –McClusky methods, Solution using Kmaps, SOP & POS representation of digital logic and their reduction using K-map, BCD to 7- segment converter, Multiplexer and demultiplexer, encoder, decoder, Half and Full adder design	8
III	**Sequential Logic Design:** Various flip flops (R-S, D, J-K, T) using gates, counter using J-K flip-flops, shift Register using flip-flops, study of different ICs (7490, 7495, 74LS138, 7447) Timer IC (555), IEEE / ANSI symbols Analog Electronics: OP-AMP (741), Basics of OP-AMP, Characteristics, Adder, Substractor, Integrator, Differentiator, Comparator using OP-amp	8
IV	**8085 Microprocessor:** Introduction: Introduction to Microprocessor, Features of 8085, 8085-CPU architecture, Demultiplexing of address and data bus, Instruction fetching and execution operation of microprocessor.	4
V	**8085 Instruction Set:** Instruction formats, addressing modes, Op-code formats, Classification of Instruction set, Programming technique, Instruction timings, WAIT state, Single step and single cycle execution.	8
VI	**Interrupt and DMA Transfer:** Types of Memory, Memory organizations Mapping of I/O 8085 Interrupts RST5.5, RST6.5, RST7.5, TRAP & INTR. Designing hardware for INTR, Interrupt priorities, SIM and RIM instruction, DMA transfer, HOLD and HLDA pins for DMA transfer. I/O Operation and interfacing: Devices, IN & OUT Instruction with timing diagrams study of 8255 PPI, Interfacing Keyboards, Interfacing Thumbwheel switches, 8253.	8
Text Books		
i)	"Modern Digital Electronics" 4thEdition,By R.P.Jain	
ii)	Microprocessor Architecture Programming & Application", Ramesh Gaonkar, Willey Estern.5 th Edition	
iii)	Digital Systems-Principals and Application", Tocci, Widmer, Moss, (Pearson Education) 11th Edition	
iv)	Design with operational amplifier", Sergio Franko and book by RamakantGaiekwad4 th Edition	
Reference Books		
i)	"Fundamentals of digital circuits", B.Anandkumar 4th Edition	
ii)	Digital Systems & Microprocessor", Douglas Hall MGH3 rd Edition	
iii)	Digital Logic and Computer Design",Book by M. Morris Mano 5th Edition	

Experiment No.	Experiment Title/Objective	Hours
1.	Study of Basic gates.	02
2.	Study of Universal gates	02
3.	Study of Boolean algebra & De Morgan's theorem using gates.	02
4.	Study of MUX/DEMUX.	02
5.	Study of 74138	02
6.	Study of R-S and J-K flip-flops	02
7.	Study of counters	02
8.	Interfacing of counters to seven segment display.	02
9.	Realization of 4/5 variable K-maps	02
10.	Study of 8085.	02
11.	Assembly language programming for 8085 (Arithmetic, Logical and data transfer- Minimum 8 programs).	02
12.	Writing subroutine to perform delay operation of 10 ms	02
13.	Designing & implementing hardware for INTR	02
14.	Study of 8255. Interfacing using 8255	02
15.	Study of 8253 interfacing.	02

General Instructions: Students have to perform 8-10 practical's from the list

Reference Books

1	"Digital Logic and Computer Design "Book by M. Morris Mano5 th Edition
2	Fundamentals of logic design "Book by Charles H Roth7 th edition
3	Microprocessor Architecture , Programming and Applications with the 8085 written by Ramesh .
4	Fundamentals of digital circuits", B.Anandkumar 4th edition

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B.Tech (Computer Science and Technology) , Part II, Semester III</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC213</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core Courses</td></tr>
<tr><td>Course title</td><td colspan="6">Data Structures</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>04</td><td colspan="2">07</td><td>05</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>50</td><td>50</td><td>200</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Basic understanding of C programming language and basic mathematics.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed at-
1. Provide the knowledge of basic data structures and their implementations.
2. Demonstrating data structures such as arrays, stacks, queues, hash tables and linked list etc.
3. Understanding searching and sorting techniques.
4. Introducing the concepts of trees and graphs.
5. Understanding the hashing technique.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –
1. Implement abstract data types using arrays and linked list.
2. Apply the different linear data structures like stack and queue to various computing problems.
3. Implement different types of trees and apply them to problem solutions.
4. Discuss graph structure and understand various operations on graphs and their applicability
5. Analyze the various sorting and searching algorithms.
6. Understand the hashing technique and hash functions.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3														
CO 2				3	1										
CO 3	2	2		2	1								2		
CO 4	3	2		3	1								2		
CO 5	2	2	1	2	1										
CO6	1	2													

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Stacks and Queue** Fundamentals stack and queue as ADT, Representation and Implementation of stack and queue using sequential and linked organization, circular queue: representation and implementation, Application of stack for expression evaluation and for expression conversion, Recursion, Priority queue, Doubly Ended Queue	7
II	**Searching and sorting Search:** Importance of searching, Sequential, Binary, Fibonacci search algorithms Sorting: Quick sort, two-way merge sort, heap sort, shell sort, Radix sort.	7
III	**Linked list** Concept of linked organization, Singly linked list, doubly linked list and dynamic storage management, circular linked list, Operations such as Insertion, deletion, inversion, concatenation, Computation of length, traversal on linked list, Representation & manipulations of polynomials using linked lists.	7
IV	**Hashing** Definition, Hash functions, Overflow, Collision, Open Hashing, closed hashing, Rehashing Techniques.	5
V	**Tree** Basic Technology, Binary Tree, Traversal methods, Binary search tree, B tree, B+ tree, Heaps-operations and their applications.	6
VI	**Graph** Basic concepts of graph theory, storage representation and manipulation of graphs, Introduction to Sparse matrix, representation of sparse matrix using linked list.	7
Text Books		
i)	Data Structure using C -- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein (PHI). 2nd Edition	
ii)	Data Structures using C – ISRD Group, TMH publication 2nd Edition	
Reference Books		
i)	Data structures and Algorithms -- Alfred V. Aho, John E. Hopcroft, J. D. Ullman (AddisionWesely Series)	
ii)	Data structures -- Seymour Lipschutz (MGH) Schaum's Outlines. 4th Edition	
iii)	Introduction to Data Structures in C – Ashok N. Kamthane (Pearson Education). 2nd Edition	
iv)	Data Structures- A Pseudo code Approach with C – Richard F. Gilberg and Behrouz A. Forouzon 2nd Edition	

Experiment No.	Experiment Title/Objective	Hours
1.	Write a program for matrix Manipulation using array.	02
2.	Implement Tower of Hanoi problem using recursion.	02
3.	Implement different operations on string without using library function.	02
4.	Implementation of palindrome string.	02
5.	Implement different operation on file.	02
6.	Implement stack as an ADT. Perform push() and pop() operations on it.	02
7.	Implementation of queue using array.	02
8.	Implement circular queue and double ended queue using arrays.	02
9.	Write a program for sequential search and linear search.	02
10.	Apply following searching techniques on list or array: Binary ii) Fibonacci	02
11.	Implement following sorting techniques on list or array: i) Quick sort ii) Merge sort.	02
12.	Write a program to create linked list and perform operation such as insert, delete, update, reverse	02
13.	To implement of binary tree traversal.	02
14.	To study hashing techniques.	02
15.	To study graph traversal method.	02
General Instructions: Practical Journal Assessment, Internal practical Examination and External Practical Examination		

Reference Books	
i)	Data Structure using C -- A. M. Tanenbaum, Y. Langsam, M. J. Augenstein (PHI).
ii)	Data Structures- A Pseudo code Approach with C – Richard F. Gilberg and Behrouz A. Forouzon 2ndEdition
iii)	Data structures -- Seymour Lipschutz (MGH) Schaum's Outlines.
iv)	Data structures and Algorithms -- Alfred V. Aho, John E. Hopcroft, J. D. Ullman (Addision- Wesely Series)

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B. Tech (Computer Science and Technology) , Part II, Semester III</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC214</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="6">Data Communication and Networking</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>02</td><td colspan="2">05</td><td>04</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>--</td><td>50</td><td>150</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Basics of Communication and Computers</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed at -
1. Providing knowledge about basics of Data Communication and computer network
2. Providing knowledge about the Functions of Physical Layer.
3. Providing details of different data link layer functions including error detection and error corrections.
4. Providing knowledge about different framing techniques and network layer protocols for data communication
5. Providing detail knowledge of Transport Layer and protocols.
6. Providing knowledge about protocols from application layer.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –
1. Explain Data Communications System, its components and Articulate the networking Basics.
2. Explain and examine wired and wireless communication with medium access control layer. Differentiate and analyze various multiplexing techniques.
3. Apply error control techniques and study different protocols used at Data Link Layer.
4. Examine IPv4 and IPv6 structure. Solve sub-netting problems and analyze various routing mechanism, Identify and compare congestion control mechanisms
5. Examine the services provided by transport layer and have a hands-on experience of socket programming
6. Inspect the networking applications used in everyday tasks such as reading email or surfing the web and analyze its architecture</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3														
CO 2	2	1	1												
CO 3	2	1	1		1								1		
CO 4	2	2	2	1	2								1		
CO 5	2	2	2	1	2								1		
CO6	1	2	2	1	2								1		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Communication Fundamentals, Protocols and Models :** Introduction to data communications, data and signals, transmission impairment, Network Representations and Topologies, Common Types of Networks, Internet Connections, Layered network model: OSI, TCP/IP	06
II	**Physical Layer Characterization:** Purpose of the Physical Layer, transmission media: - Guided and Unguided media, Network Hardware components, Introduction to packet switching: Circuit switching vs. packet switching, Types of services: - Connection oriented services, Connectionless services, Multiplexing	05
III	**Data Link Layer:** Purpose of the Data Link Layer, Error detection & correction: cyclic codes, hamming code, Data Link Control: - Farming, Flow & error control, Protocol basics- stop & wait protocol, sliding window protocol, MAC protocols, ALHOA, CSMA, CSMA/CD, CSMA/CA	09
IV	**Network Layer:** Network Layer Services, Network Layer Performance: Delay, throughput, congestion control, IPv4 Addresses: Address space, Classful addressing, classless addressing, IP datagram format, IPv6 Address Representation, IPv6 Address Types, Introduction to Network Routing Algorithm- Link State routing, Distance Vector Routing etc	09
V	**Transport Layer:** Transportation of Data, TCP Overview, UDP Overview, Port Numbers, TCP Communication Process, Reliability and Flow Control, UDP Communication	05
VI	**Application Layer:** Application, Presentation, and Session, Peer-to-Peer, NAME SPACE, DOMAIN NAME SPACE, Web and Email Protocols, File Sharing Services, Security Threats and Vulnerabilities, Network Attacks	05
Text Books		
i)	B. A. Forouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2013, ISBN-10: 1-25-906475-1	
ii)	Computer Networks – Andrew S. Tanenbaum (Pearson Education) 4th Edition	
Reference Books		
i)	William Stallings, "Data and computer Communication", 7th Edition, Pearson Education, 2003, ISBN-13: 978-0131006812, ISBN-10: 0131006819.	
ii)	Larry L. Peterson and Bruce S. Davie, "Computer Networks a systems approach", 5th Edition, Morgan Kaufmann an imprint of Elsevier, 2014, ISBN: 978-93-80501-93-2	

Experiment No.	Experiment Title/Objective	Hours
1.	Study and demo of LAN, WAN and various connecting devices and components.	02
2.	Study of Different Networking Command	02
3.	Implementation of Framing Method By Character Count	02
4.	Implementation of Error Detecting Code (CRC)	02
5.	Implementation of Error Correcting Code (Hamming Code).	02
6.	Implementation of Simplex Stop and Wait Protocol.	02
7.	File transfer using Go back n / Selective Repeat Protocol	02
8.	Implementation of Shortest Path algorithm	02
9.	Implementation of connection oriented (TCP) client-server socket program.	02
10.	Implementation of connectionless (UDP) client-server socket program.	02
11.	Study of network protocol analyzer (Wire-Shark) / (Packet sniffer) and understanding packet formats for UDP, TCP, ARP, ICMP protocols	02
12.	DNS client utilities with Nslookup and Dig	02
13.	Implement simple web page design	02
14.	Case study of campus-wide network	02

General Instructions: Students have to perform 8-10 practicals from the list

Reference Books

i)	Richard Steven, "Unix network programming", for Socket Programming, Prentice Hall 3rd edition, 2015
ii)	James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education,5th /6th edition, 2012/2013
iii)	Jeffery S. Beasley, "Networking", New Riders Press, 2nd edition, 2008.

Year, Program, Semester	S.Y. B. Tech (Computer Science and Technology) , Part II, Semester III					
Course Code	AEC211					
Course Category	Ability Enhancement Courses					
Course title	**Soft skills Development**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	01	-	-	01		01
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		50	-	50
Pre-requisites(if any)	H. S. C. Level English language competency					
Course Rationale:	In today's competitive professional landscape, technical skills alone are insufficient. Soft skills such as communication, teamwork, problem-solving, and adaptability are essential for engineering graduates to thrive in their careers. This course aims to equip students with the necessary soft skills to complement their technical expertise and enhance their employability and success in the workplace.					
Course Objectives	The Course aimed at - 1. Enhancing communication, teamwork, problem-solving skills. 2. Fostering adaptability and resilience in engineering contexts.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Proficient in oral and written communication. 2. Effective as regards teamwork and collaboration skills. 3. Able to apply critical thinking to industrial problems. 4. Able to demonstrate adaptability and resilience in profession.					

Course Outcome and Program Outcome Mapping

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1									3	3	-				
CO2									3	-	-				
CO3		3													
CO4												2			

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Written communication** • Email Writing • Technical Report	03
II	**Oral Communication** • Presentation Skills	02
III	**Soft Skills** • Importance of Soft Skills • Overview of Various Soft Skills	02
IV	**Team Spirit & Leadership Ability** • Understanding team dynamics and roles • Building trust and rapport within team	02
V	**Assessment** • Discussion on incorporating soft skills development into daily practice • Case Studies or Role-Play	05
Text Books		
i)	1. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.	
Reference Books		
i)	Sharma R. & Krishna Mohan (2017), *Business Correspondence and Report Writing*, McGraw Hill Education	
ii)	P. D. Chaturvedi & Mukesh Chaturvedi (2013), *Business Communication: Skills, Concepts & Applications*, Pearson Publications, New Delhi, 3rd Edition, Seventh Impression	
iii)	K. K. Sinha (2006), *Business Communication*, 2nd Edition (Reprint), Galgotia Publishing, New Delhi	
iv)	Khera, S. (1998). "You Can Win: A Step by Step Tool for Top Achievers." New Delhi: Macmillan Publishers India.	
v)	Covey, S. R. (2004). "The 7 Habits of Highly Effective People." New York: Free Press.	
vi)	Carnegie, D. (2009). "How to Win Friends and Influence People." New York: Pocket Books.	
vii)	Bradberry, T., & Greaves, J. (2009). "Emotional Intelligence 2.0." San Diego, CA: TalentSmart.	
viii)	Dweck,C.S.(2006). "Mindset: The New Psychology of Success." New York: Ballantine Books.	
Assessment		

	For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure comprehensive assessment of the students' performance. Following Evaluation Components are suggested: **1. Quizzes/Tests (10 marks)** Periodic quizzes or tests to evaluate students' understanding of key concepts and their ability to apply them. **2. Activity 1 (10 marks)** Group activity focusing application of creative thinking and teamwork; designed to assess both individual and group performance 3. **Activity 2 (20 marks)** Group activity focusing application of creative thinking and teamwork; designed to assess both individual and group performance **4. Classroom Participation and Engagement (10 marks)** Demonstrating engagement with course material and Active participation in class discussions, group activities and question-answer sessions. .

Year, Program, Semester	S.Y. B. Tech (Computer Science and Technology) , Part II, Semester III			
Course Code	PBL211			
Course Category	Project Based Learning			
Course title	**Mini Project I**			
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**
	-	01	-	01
Evaluation Scheme	IE at Course in charge end			
Pre-requisites(if any)	Basics of Computers			
Course Objectives	The Course is aimed to- 1. Create awareness among the students to express technical ideas, strategies and methodologies in written form. 2. Enable students to work as a responsible member and possibly a leader of a team in developing software solutions. 3. Motivate students to self-learn new tools, algorithms, and/or techniques that contribute to the software solution of the project 4. Create awareness among the students of the characteristics of several domain areas where IT can be effectively used. 5. Improve the team building, communication and management skills of the students 6. Enable students to develop a design solution for a set of requirements			
Course Outcomes	Upon completion of this course, student should be able to – 1. Acquire practical knowledge within the chosen area of technology for project development 2. Identify, analyze and handle programming projects with a comprehensive and systematic approach 3. Contribute as an individual or in a team in development of technical projects 4. Develop effective communication skills for presentation of project related activities 5. Formulate and propose a plan for creating a solution for the problem identified 6. Report and present the findings of the study conducted in the preferred domain			

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1		2	2												
CO2		2	2	2											
CO3									2	2					
CO4							2								
CO5						2									
CO6											2	2			

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Mini Project I is a dynamic course designed to bridge the gap between classroom learning and real-world application. Throughout the semester, all students will engage themselves in a series of mini projects that challenge them to apply theoretical concepts learned in previous courses to solve practical problems. These projects, conducted in small groups, will cover a range of topics relevant to their field of study, allowing students to explore different facets of their discipline and develop versatile skill sets.

The course structure is carefully crafted to align with NEP 2020 and Outcome Based Education principles, emphasizing experiential learning, competency development, and holistic skill enhancement. Through active participation in mini project, students will not only deepen their understanding of academic concepts but also cultivate essential soft skills such as teamwork, problem-solving, and effective communication.

Each week, students will dedicate one hour to course activities, including project discussions, progress updates etc. Faculty guidance and mentorship will be provided to support students throughout their project work, ensuring they maximize their learning outcomes and derive meaningful insights from their engagements.

By the end of the semester, students will emerge with a comprehensive understanding of how theoretical knowledge translates into practical applications, equipping them with the competencies and confidence to thrive in their future careers.

The mini-project should be undertaken preferably by a group of 3 students who will jointly work and implement the mini-project. The group will select a project with the approval of the guide. A batch of practical / Tutorial will be divided into mini project groups. Mini project topics and the work for these groups in the batch will be guided by a teacher for the batch, preferably on one of the topics like Compiler Construction, Database Engineering, Operating System, Computer Graphics and Multimedia, Advanced Programming and latest developments and trends in Computer Science and Technology. The teacher will periodically assess the performance of individual student in the mini project, jointly with a teacher of another batch. Project group will submit hardcopy project report along with project demonstration software in CD and/or project hardware gadget at the term end. The IOE of mini project will be jointly conducted by appointed examiners. Note: Use of Open source tools should be preferred.

Course Assessment Process

The course evaluation will be at the course teacher end. The teachers will follow the instructions as below:

- Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
    - Rubric-based assessment for mini project.
    - Peer evaluation for team-based projects.
    - Written exams or quizzes to assess theoretical knowledge.
    - Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
    - Overall course grading based on a weighted average of individual assessments and participation.

Year, Program, Semester	S.Y. B. Tech (Computer Science and Technology) , Part II, Semester III				
Course Code	HSMEC211				
Course Category	Humanities, Social Science, Management, Environment				
Course title	**Environmental Studies**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	02	-	-	02	00
Evaluation Scheme	SEE: 70 Marks + IOE: 30 Marks, evaluation only at Even Semester End.				
Pre-requisites (if any)	BSC111, BSC121				
Course Rationale	The Course is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting nature.				
Course Objectives	The Course Teacher will 1. Introduce students to the fundamental concepts and principles of environmental science. 2. Describe the components of various ecosystems and their interrelationships. 3. Classify different types of natural resources and assess their availability and distribution. 4. Define biodiversity and its significance to ecosystem functioning and human well-being.				
Course Outcomes	Upon completion of this course, student should be able to 1. Define key terms and concepts related to environmental science. 2. Analyse ecosystem services and their importance to human well-being. 3. Identify various types of natural resources and their significance. 4. Describe the levels and patterns of biodiversity and their importance.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO 1	3	2	-	-	-	-	3	3	-	-	-	-	-	-	-
CO 2	-	3	3	-	-	-	3	3	3	2	-	-	-	-	-
CO 3	-	2	3	-	-	-	3	3	3	3	-	-	-	-	-
CO 4	-	2	-	-	-	-	3	3	3	3	-	-	-	-	-

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I.	**Nature of Environmental Science:** Definition, scope and importance. Multidisciplinary nature of environmental studies. Need for public awareness. Introduction to sustainable development: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	**04**
II.	**Ecosystem:** Concept of an ecosystem, Structure and function of an ecosystem, Producers,	**06**

	consumers and decomposers, Energy flow in the ecosystem, Ecological succession. Food chains, food webs and ecological pyramids, Introduction, types, characteristics features, structure and function of the Following ecosystem: - a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) Degradation of ecosystems and its impacts.	
III	**Natural Resources and Associated Problems:** Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water scarcity and stress; Conflicts over water. c) Soil and Mineral resources: Soil as resource and its degradation, Usage and exploitation, Environmental effects of extracting and using mineral resources, Wasteland reclamation, d) Energy resources: Growing energy needs, renewable and non- renewable energy resources, use of alternate energy sources. Solar energy, Biomass energy, Nuclear energy, e) Role of Indian traditions and culture in conservation of the environment.	**08**
IV	**Biodiversity and its conservation:** Introduction- Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, India as a mega- diversity nation. Western Ghats as a biodiversity region. Hot-spots of biodiversity, Threats to biodiversity habitat loss, poaching of wildlife, man- wildlife, Conflicts, Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone.	**07**
	Nature Visits / Field Work /Field Tour/ Industrial visits / Activities related to Campus environmental management	**05**

Text Books

i)	Agarwal, K. C., (2001), Environmental Biology, Nidi Publ. Ltd., Bikaner.
ii)	Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 380013, India.
iii)	Brunner R. C., (1989), Hazardous Waste Incineration, McGraw Hill Inc, 480p.

Reference Books

1.	Cunningham, W. P. Cooper, T. H. Gorhani, E. & Hepworth, M.T., (2001), Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
2.	Gleick, H., (1993), Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press 473p.
3.	Hawkins R. e., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
4.	Heywood, V. H. & Watson, R. T., (1995), Global Biodiversity Assessment, Cambridge Univ. Press.
5.	Jadhav, H. & Bhosale, V. M., (1995), Environmental Protection and Laws, Himalaya Pub. House, Delhi, 284p.
6.	Mckinney, M. L. & Schocl. R. M., (1996), Environmental Science Systems & Solutions, Web enhanced edition.
7.	Odum, E. P., (1971), Fundamentals of Ecology, W. B. Saunders Co. USA, 574p.
8.	Rao M. N. & Datta, A. K., (1987), Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd.

9.	Sharma B. K., (2001), Environmental Chemistry, Goel Publ. House, Meerut.
10.	Trivedi R. K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R).
11.	Trivedi R. K. and P. K. Goel, Introduction to air pollution Techno-Science Publications (TB).
12.	Wagner K. D., (1998), Environmental Management, W. B. Saunders Co. Philadelphia, USA.

Important web links	
1.	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
2.	http://nitttrc.edu.in/nptel/courses/video/109105203/L41.html

Year, Program, Semester	S.Y. B. Tech (Computer Science and Technology) , Part II, Semester IV					
Course Code	BSC221					
Course Category	Basic Science Courses					
Course title	**Applied Mathematics – II (Numerical Methods and Statistics)**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	--	--	100
Pre-requisites(if any)	Basic knowledge of Mathematics-I					
Course Objectives	The Course is aimed at – 1. Elaborating numerical methods and statistics. 2. Analyzing engineering problems based on probability 3. Familiarizing with correlation and regression 4. Providing knowledge of the Test of Hypotheses and Significance. 5. Discussing and solve Transportation Problem.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the difficulty of solving problems analytically and the need to use numerical approximations for their resolution 2. Apply numerical methods for solving problems in different areas of engineering 3. Gain the basic knowledge of correlation and regression. 4. Formulate and solve different problems in the field computer engineering using probability and test of Significance 5. Analyze and solve engineering problems using transportation problem. 6. Formulate a mathematical model for engineering problem, solve and interpret the solution in real world.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	3	2	1			1									
CO2	3	2	1			1									
CO3	3	2			2										
CO4	3	2			2										
CO5	3	2													
CO6	3	2	2			1									

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Numerical solution of algebraic and transcendental equations** Zeroes of polynomial and transcendental equation using Bisection method, Iterative method, Secant method, Regula-falsi method and Newton-Raphson method, Newton-Raphson method for system of equations, Mullers method, Rate of convergence of above methods.	7
II	**Interpolation, Numerical Differentiation and Numerical Integration** Lagrange's interpolation formula, Newton's forward and backward difference interpolation formula, Newton's divided difference interpolation formula, Numerical differentiation based on interpolation, Numerical Integration: Trapezoidal Rule, Simpson's 1/3 rd rule, Simpson's 3/8 th rule.	6
III	**Curve Fitting** Fitting of Curves by method of Least-squares for linear, parabolic, and exponential, Coefficient of correlation, Spearman's rank correlation, coefficient and lines of regression of bivariate data.	7
IV	**Probability** Random variable, Mean, median, mode and standard deviation. Binomial, Poisson, and Normal distributions.	6
V	**Test of Significance** Sampling distribution of mean and standard error, Large sample tests: Test for an assumed mean and equality of two population means. Small sample tests: t-test for an assumed mean and equality of means of two populations, Paired t-test. Test by using Chi – square distribution. Goodness of fit test. Test for independence of attributes Yates's Correction.	7
VI	**Transportation Problem** Introduction, Mathematical formulation, Method for obtaining initial basic feasible solution, North –West corner method, Low cost entry method, Vogel′s approximation method, Method to obtain optimal solution (MODI Method).	6
	Text Books	
i)	M. K. Jain, S. R. K. Iyengar, R. K. Jain, "Numerical methods for scientific and Engineering Computation" , 2012, New Age International Limited Publishers.	
ii)	S. C. Gupta and V. K. Kapoor, "Fundamentals of Mathematical Statistics", 2020.	
iii)	B. S. Grewal, "Higher Engineering Mathematics", 43rd Edition , Khanna Publishers, Delhi.	
iv)	S. D. Sharma, "Operations Research ", 11th Edition	
	Reference Books	
i)	S.C. Chapra, R.P. Canale, "Numerical method for Engineers", 2015, Tata McGraw Hill Publications	
ii)	James L. Johnon, "Probability and Statistics for Computer science", 2011.	
iii)	H. K. Dass, "Advanced Engineering Mathematics", 2014, S. Chand Publishing.	
iv)	Erwin Kreyszig, "Advanced Engineering Mathematics", Fifth Edition , John Wiley & Sons.	
v)	M. D. Greenberg, "Advanced Engineering Mathematics", 2nd Edition , Pearson Education.	
vi)	C. R. Wylie, "Advanced Engineering Mathematics", 6th Edition , McGraw Hill Publication, New Delhi.	

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC221</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core Courses</td></tr>
<tr><td>Course title</td><td colspan="6">Theory of Computation</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td colspan="2">03</td><td>03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td colspan="2">ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td>30</td><td colspan="2">70</td><td>--</td><td>--</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Discrete Mathematical Structure</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed at –
1. Helping students to develop ability to understand and conduct mathematical proofs for computation and algorithms
2. Introducing students to the mathematical foundations of computation including automata theory.
3. Demonstrating students to design DFA and NFA for solution to engineering problems.
4. Explaining the theory of formal languages and grammars.
5. Demonstrating the PDA and normal forms of grammar.
6. Explaining different types of Turing Machines</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –
1. Analyze problem solving situations in related areas of theory in computer science.
2. Enhance ability to understand and conduct mathematical proofs for computation and algorithms.
3. Design deterministic and nondeterministic automata to recognize specified regular languages
4. Analyze and design finite automata, pushdown automata, formal languages, and grammars.
5. Convert among equivalently powerful notations for a language, including among DFAs, NFAs, and regular expressions, and between PDAs and CFGs.
6. Design and analyze Turing Machine</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	2	3	3	2											
CO2	3	2	2												
CO3	3	2	3												
CO4	1		3												
CO5	2		2												
CO6	1		3	2											

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	Proofs and Regular Languages: Types of Proofs, Mathematical Induction and Recursive definitions with examples. Regular expressions & corresponding regular languages, examples and applications, unions, intersection & complements of regular languages.	6
II	Finite State Machines: Deterministic finite automata definition and representation, Non-deterministic F.A., NFA with ^ transitions, Equivalence of DFAs, NFAs and NFA-^s. Kleene's theorem - part I & II statements & proofs, minimum state FA for a regular language, minimizing number of states in an FA.	10
III	Grammars & Languages: Definition and types of grammars and languages, derivation trees and ambiguity, CFL's & Non CFL's., Union, Concatenation and Kleene's operations, Intersection and complements of CFLs, Pumping Lemma & examples.	6
IV	Chomsky Normal Form: BNF and CNF notations, Eliminating ^ production and unit productions from a CFG, Eliminating useless variables from a Context Free Grammar.	3
V	Push Down Automata: Definition, deterministic PDA, types of acceptance and conversions to each other, CFGs & PDAs., Top-Down, & Bottom-up parsing.	6
VI	Turing Machines: Models of computation, definition of TM as Language Acceptors, Combining Turing machines, computing a function with a TM. Variations in TM, TMs with doubly-infinite tapes, more than one tape, Non-deterministic TM and Universal TM.	8
Text Books		
i)	Introduction to Languages & Theory of Computation", John C. Martin, TMH, 3rd Edition.	
ii)	"Discrete Mathematical Structures with Applications to Computer Science", J. P. Tremblay & R. Manohar, Tata McGraw-Hill Edition, 35th Reprint.	
Reference Books		
i)	"Introduction to Automata Theory, Languages and Computations", John E. Hopcraft, Rajeev Motwani, Jeffrey D. Ullman (Pearson Edition).	
ii)	"Introduction to Theory of Computations", Michael Sipser, Thomson Brooks/Cole.	

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV					
Course Code	PCC222					
Course Category	Program Core Course					
Course title	**Advanced Microprocessor**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	02	05		04
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	50	200
Pre-requisites(if any)	Basic knowledge of microprocessor					
Course Objectives	The Course is aimed at – 1. Analyzing the architecture, instruction set and operations of microprocessors 8086 and contemporary peripherals. 2. Elaborating the single and multiprocessor mode of 8086 processor. 3. Discussing to develop assembly level programs for microprocessor and microcontroller. 4. Describing and analyze 80386 microprocessor and PIC microcontroller. 5. Illustrating and analyze I/O Interfacing and Interrupt handling concept and to implement these concepts with Intel 8086 Assembly Language. 6. Elaborating the operation of microprocessors and microcontrollers, machine language programming and interfacing techniques.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Get complete knowledge of architecture, instruction sets and operations of microprocessors 8086. 2. Understand 8086 microprocessor, multiprocessor addressing modes. 3. Develop various assembly language programs and understands the various addressing modes required for assembly language programming. 4. Develop enough confidence to take up the challenges in building useful microprocessor based applications. **5.** Analyze instruction sets, applying programming and gain hands-on experience of 8086 & 80386 microprocessor and microcontroller. 6. Outline the architecture of ARM processor and PIC microcontroller.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	1	2		2											
CO2		2													
CO3	1	2													
CO4					1										
CO5		2			1										
CO6	1	2													

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**8086 Architecture** 8086 CPU Architecture, EU & BIU activities, Segmentation and address transition, 8086 pin description, 8284 clock generation 8286, 8282, configuration of 8086. Accessing even and add address memory with byte/ word. Software and Hardware interrupts.	8
II	**8086 Addressing modes and instruction sets** Addressing modes, data Transfer, arithmetic logical string, i/o instruction, control group of instruction, writing programs using assembler directive and in different module and linking, BIOS /DOS interrupts for Printer, VDU, serial, FDC, Add on cards interface.	8
III	**Minimum & Maximum mode of 8086** Multifunction pins of 8086, 8088-Bus controller, IOB mode of 8288, Minimum & Maximum mode Configuration diagram. Study of 8087 NDP	3
IV	**Modular Programming** Linking and relocation, Stacks, procedures, interrupt and interrupt routines, macros, program design, program design examples.	4
V	**80386, 32~bit processor** Salient features of 80386DX, Architecture and signal description, Register organization, addressing modes, data types, Real address mode, protected mode, Segmentation, Paging.	5
VI	**Embedded System and other Microcontrollers** PIC Microcontroller 8 bit Microcontroller, architecture, Addressing Modes, Timers, Counters, Interrupts, Serial Communication, Programming Concepts, design of embedded systems with microcontrollers.	11
Text Books		
i)	"8086/8088 Family design programming and interfacing", John Uffenbeck, PHI.8 th Edition.	
ii)	"Design with PIC Microcontrollers", John B. Peatman, Pearson Education.4 th Edition	
Reference Books		
i)	"The INTEL Microprocessor".	
ii)	"An introduction to 8086/8088 assembly language programming for beginners", N. M. Morris.	
iii)	"Microcomputer Systems: The 8086 / 8088Family Architecture, Programming and Design", Yn - cheng Liu and Gibson, G.A. Prentice Hall of India, 2nd Edition, 2006.	

Experiment No.	Experiment Title/Objective	Hours
1.	8086 Architecture: To understand 8086 Architecture in details.	02
2.	Implement 8086 program for addition and subtraction of two 16 bit numbers.	02
3.	Implement 8086 program for signed and unsigned multiplication.	02
4.	Implement 8086 program for signed and unsigned division	02
5.	Implement 8086 program to check number is even or odd.	02
6.	Implement 8086 program for check number is positive or negative.	02
7.	Implement a program: a)To find largest number from array. b)To find smallest number from array.	02
8.	Implement program for password matching.	02
9.	Implement a program to display a string and to do case conversion.	02
10.	Implement a program to string reverse and string copy.	02
11.	Implement a program: a)To sort numbers in ascending order. b)To sort numbers in descending order.	02
12.	Implement a program for counting 1's and 0's.	02
13.	Write NDP architecture in detail with diagram.	02
General Instructions: Practical Journal Assessment, Internal Oral Examination and External Practical Examination		
Reference Books		
i)	"8086/8088 Family design programming and interfacing", John Uffenbeck, PHI.2nd Edition	
ii)	"An introduction to 8086/8088 assembly language programming for beginners", N. M. Morris	

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC223</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="6">Computer Organization</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td colspan="2">03</td><td>03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>--</td><td>--</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Basic knowledge of digital logic and computer hardware basics</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed at-
1. Conceptualizing the basics of organizational and architectural issues of computer
2. Helping to analyze performance issues in processor and memory design of a computer.
3. Discussing various data transfer techniques in computer.
4. Explaining to analyze processor performance improvement using instruction level parallelism.
5. Providing the knowledge on Instruction Level Parallelism.
6. Providing the knowledge and Analyze Memory Organization.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –

1. Understand basic structure of computer.
2. Perform computer arithmetic operations.
3. Understand control unit operations.
4. Design memory organization that uses banks for different word size operations.
5. Understand the concept of cache mapping techniques. Ability to understand the concept of I/O organization
6. Conceptualize instruction level parallelism</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	2														
CO2	1		2												
CO3	1														
CO4			2												
CO5	1	1													
CO6		2													

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	**Basic Computer Organization:** Evolution of computers - Mechanical era, Electronic computers, Generations, VLSI era, CPU organization , communications, user and supervisor modes, accumulator based CPU, System bus, instruction cycle, types of instruction(zero, one, two and three address machines), IO interface, RISC & CISC, definition, comparison and examples.	3
II	**CPU design:** Specifications, (memory, speed, frequency etc.) with example, Instruction fetching, decoding, executing, Case Study (architecture, block diagram, instruction sets etc.), Pentium 4 processor, AMD processor.	8
III	**Computer Arithmetic:** Data Representation, basic formats, storage order, fixed point numbers, binary, signed, decimal, hexadecimal, Floating point numbers, basic formats, normalization, biasing, IEEE754 format, Fixed point arithmetic - Addition and subtraction, overflow, high speed adders, adder expansion, Fixed point multiplication - Two's complement multiplier, Booth's algorithm, Combinational array multiplier, Fixed point division - Restoring, Non restoring algorithm, Combinational array divider, Division by repeated multiplication, Floating point arithmetic - Basic operations, Difficulties, Floating point units, Addition, subtraction, multiplication, division.	8
IV	**Control Design:** Introduction, multi cycle operation, implementation methods, Hardwired control, design methods, state tables, GCD processor, Classical method, one hot method, Design example- twos complement multiplier control, CPU control unit design.	4
V	**Micro programmed control:** Basic concepts, control unit organization, parallelism in microinstructions, Microinstruction addressing, timing, Control unit organization, Design example- twos complement, multiplier control, Control field encoding, encoding by function, multiple microinstruction formats.	8
VI	**Memory Organization:** Types of memory, Memory systems, multilevel, address translation, memory allocation, Caches, Associative memory, direct mapping, set associative addressing.	8
Text Books		
i)	Computer Architecture and Organization - John P Hayes (MGH) 3rd Edition.	
ii)	Computer Systems Organization & Architecture – John D. Carpinelli (Pearson Education)	
Reference Books		
i)	Computer Organization - HamacherZaky (MGH).	
ii)	http://cse.stanford.edu/class/sophomore-college/projects-00/risc/risccisc/ (RISC vs CISC)	
iii)	http://www.cpu-world.com/sspec/	
iv)	http://www.intel.com/technology/itj/q12001/pdf/art_2.pdf (The Micro architecture of the Pentium 4 Processor).	
v)	http://www.amd.com/usen/assets/content_type/white_papers_and_tech_docs/30579_AMD_Processor_ Evaluation_Guide3.1.pdf (AMD Processor Performance Evaluation Guide)	

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC224</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core Course</td></tr>
<tr><td>Course title</td><td colspan="6">Software Engineering</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td colspan="2">03</td><td>03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td colspan="2">ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td>30</td><td colspan="2">70</td><td>--</td><td>--</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Basics of Computers</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed at-
1. Providing knowledge of basic Software engineering methods and practices, and their appropriate applications.
2. Giving a general understanding of software process models such as the waterfall and evolutionary models and an understanding of software requirements and the SRS document.
3. Elaborating to know role of project management in planning, scheduling, risk management, different software architectural styles, implementation issues such as modularity and coding standards.
4. Providing knowledge of software testing approaches such as unit testing and integration testing and understanding of software evolution and related issues such as version management.
5. Illustrating quality control and how to ensure good quality software.
6. Explaining some ethical and professional issues that are important for software engineers and development of significant teamwork and project based experience.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –

1. Apply the project management and analysis principles to Software project development
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
3. Identify and solve engineering problems and to gain Knowledge about software development life cycle.
4. Communicate effectively and the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
5. Apply the design & testing principles to software project development to maintain software systems.
6. Identify and Apply methods for software quality and its control.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1		2	2								3				
CO2			3			2	2	2							
CO3		2	2												
CO4			3			3	2			2					
CO5			2		2										
CO6		1			2										

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	**Introduction to Software Engineering:** The Problem Domain, Software Engineering Challenges, Software Engineering approaches, Software Processes, Software Development Process Models, Extreme programming and agile software development, Other Software Processes	6
II	**Software Requirement Engineering:** Requirement Engineering Processes, Requirement elicitation and analysis, Software Requirement Specification, Requirement Validations	7
III	**Software Architecture:** Role of software architecture, Architecture View, Component and Connector View, Architecture styles for Component and Connector View, Evaluating Architectures.	6
IV	**Software Design:** **Function Oriented Design :** Design Principles, Module Level Concepts, Design Notation and Specifications, Structure Design Methodology, Metrics **Object Oriented Design:** OO Analysis and OO Design, OO Concepts, Design Concepts, Design Methodology, Metrics.	8
V	**Coding and Testing:** Programming Principles and Guidelines, Coding Process, Refactoring, Testing, Black Box Testing, White Box Testing, Program Analysis Tools, Unit Testing, Integration Testing, System Testing	7
VI	**Software Quality and Management:** Software quality, Software standards, CMM, Reviews and inspections, Software measurement and metrics. **Case Study:** Complete a case study related to requirements gathering and analysis, designing, coding and testing phase of software development by forming a group of 3-4 students.	5

Text Books	
i)	An Integrated Approach to software engineering by Pankaj Jalote, Narosa Publication, 3rd Edition (Unit I,III,IV)
ii)	Software Engineering by Ian Sommerville, Pearson Publication, 9th Edition
iii)	Fundamentals of Software Engineering by Rajib Mall, PHI, 3rd Edition. (Unit V)
iv)	Software Engineering by Roger Pressman, McGraw-Hill Publication, 9th Edition (Unit II,VI)
v)	The Unified Modeling Language User Guide by Grady Booch, James Rumbaugh, Ivar Jacobson (Unit IV)

Reference Books	
i)	.Software Engineering - Concepts & Practices by UgrasenSuman (Cenage Learning)
ii)	Software Engineering Fundamentals -- Behforooz& Hudson (Oxford : Indian Edition 1st)

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV					
Course Code	PCC225					
Course Category	Professional Core Course					
Course title	**Linux and Shell Programming Lab**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	-	-	02	02		01
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		50	-	50
Pre-requisites(if any)	Basics of Operating System					
Course Objectives	The Course is aimed at - 1. Familiarizing students with the Linux environment 2. Teaching the Vi editor at an introductory level of proficiency 3. Familiarizing students the fundamentals of shell scripting/programming 4. Helping to perform simple concurrent programs 5. Explaining to write and use moderately complex regular expressions 6. Familiarizing students with basic Linux administration.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Use and execute basic Linux commands and understand features of Linux 2. Use Vi editor 3. Use and write Shell Programming using Linux 4. Write and use moderately complex regular expressions. 5. Perform basic Linux administration					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	3	-	-	-	-								2		
CO2	2	-	-	-	-								2		
CO3	2	-	-	-	1								2		
CO4	2	1	-	-	1								2		
CO5	2	-	-	-	1								2		

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	Introduction to Linux and Linux utilities – A brief history of Linux Architecture , Features of Linux , Linux commands- PATH, man, echo, printf, script, passwd, uname, who, date, sty, pwd, cd, mkdir, rmdir etc	3
II	The File System: Basic File Attributes, the vi Editor	4
III	The Shell, The Process, Customizing the environment	5

IV	More file attributes, Simple filters	4
V	Filters using regular expressions	5
VI	Essential Shell Programming, awk – An Advanced Filter	5

Experiment No.	Experiment Titles	Hours
1.	Introduction Linux Operating System- Linux Architecture, features of Linux, Versions of Linux	02
2.	Study basic Linux Commands	02
3.	Study File System commands and basic File Attributes	02
4.	Vi Editor: Hands-on	02
5.	Shell Script: Basic Commands	02
6.	Shell Script: Control Statements (Fibonacci Program)	02
7.	Shell Script: Function arrays- string operation and addition	02
8.	Shell Script: Head, tell, wc, sort, eval	02
9.	Shell Script: Regular expression, cut and grep command	02
10.	Shell Script: awk	02
11.	Essential system Administration concepts and commands	02
12.	Design a calculator using different commands	02

General Instructions: Students have to perform minimum 8 to 10 practical's

Text Books

i)	Unix Concepts and Applications, 4thedititon , Sumitabha Das , MGH
ii)	Linux system programming, Robert Love, O` Reilly, SPD

Reference Books

i)	Beginning Linux Programming, 4th edition, N . Mathew, R.stone, Wrox Willey India Edition
ii)	Linux, The Complete Reference , 6th edition, Richard Petersen, MGH

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV</td></tr>
<tr><td>Course Code</td><td colspan="6">PCC226</td></tr>
<tr><td>Course Category</td><td colspan="6">Professional Core</td></tr>
<tr><td>Course title</td><td colspan="6">Object Oriented Programming Lab</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>04</td><td colspan="2">04</td><td>02</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td colspan="2">ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td>-</td><td colspan="2">-</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Knowledge of Programming Methodology, ‘C’ language</td></tr>
<tr><td>Course Objectives</td><td colspan="6">The Course is aimed to-
1. Introduce students to the principals and concepts of object oriented programming paradigm
2. Familiarize students with the basics of C++ language and its features
3. Impart knowledge about inheritance and polymorphism and their implementation in C++
4. Provide an understanding of file handling and streams for input/output operations.
5. Explore advanced features of C++ including templates, standard template library and exception handling
6. Enhance problem solving skills through practical implementation of concepts learned in C++ programming.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –
1. Demonstrate solid understanding of fundamental principal of object oriented programming and its significance in software development.
2. Proficient in C++ Programming language.
3. Implement OO features like inheritance and polymorphism
4. Implement function overloading, operator overloading and virtual functions.
5. Proficient in file handling operations.
6. Utilize C++ features of exception handling.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO 3
CO1	3														
CO2			3												
CO3		2	3												
CO4			2												
CO5					2										
CO6			3												3

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	**Introduction to Object Oriented Programming:** Introduction object-oriented programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, features of OOP.	2
II	**Basics of C++ programming:** Variable declarations, global scope, const variables, reference variables, functions with default arguments, call by value, call by reference, returning by reference, call by pointer, Classes and Objects defining Class, data members, member functions, Access specifies – public, private, protected, constructor, destructor.	2
III	**Inheritance:** Need of Inheritance, Concept, public, private, protected inheritance, inheritance type, Virtual base class, method overriding, static variable, static function, friend function, friend class	2
IV	**Polymorphism:** Pointers basics of memory management, New and delete operators, Pointer to object, Pointer to data members, this pointer. Need of Polymorphism, concept, Compile time polymorphism or early binding: function over loading and operator overloading, overloading - unary, binary, arithmetic operators, relational operators, Run time polymorphism or late binding using Virtual function, pure virtual function, Abstract class, Type conversion	3
V	**Files and Streams:** Concept of Streams, concept of File, opening and closing a file, detecting end-of-file, file modes, file pointer, reading and writing characters, strings and objects to the file, operations to move file pointers i.e seekg, seekp, tellg, tellp	2
VI	**Advanced C++ features:** Introduction to Generic Programming using Templates: Function template and class template, Introduction to Standard Template Library (STL), containers, iterators and algorithms, study of container template classes for vectors and stacks and related algorithms Exception handling: Introduction, syntax for exception handling code: try-catch-throw, Multiple Exceptions, Exceptions with arguments	2

Reference Books

i)	C++: The Complete Reference Fourth Edition - Herbert Schildt (McGraw-Hill) , 4th edition
ii)	C++ programming: From Problem Analysis to Program Design Fifth Edition -D.S. Malik (Cengage Learning)
iii)	C++ Programming with language –Bjarne Stroustrup (AT & T), 4th edition
iv)	Object Oriented Programming with C++ Fourth Edition-E Balguruswamy (McGraw-Hill), 4th edition
v)	Object oriented Programming in C++ 3rd Edition-R.Lafore (Galgotia Publications), 3rd Edition
vi)	C++ programming –John Thomas Berry(PHI), 2nd Edition
vii)	Object –Oriented Analysis & Design: Understanding System Development with UML 2.0 , Docherty, Wiley India Ltd.
viii)	http://www.spoken-tutorial.org/ NMEICT Project of Govt. Of India.

Experiment No.	Experiment Title/Objective	Hours
1.	Write a program to demonstrate concept of class. For example: create class matrix, class string, class car, class date, class time, class person etc.	02
2.	Write a program to demonstrate following Function concepts a. Function overloading b. Constructors of all types c. Default parameters, returning by reference id. Demonstration of friend function e. Demonstration of static function	02
3.	Write a program to demonstrate a. Operator overloading –for unary as well as binary operation. b. Apply above concept on matrix and string classes created above	02
4.	Write a program to demonstrate C++ s capability of all types of inheritance a. Single, multiple, multivalued b. Virtual function. c. Abstract class d. Runtime polymorphism	02
5.	Write a program for new and delete operators, pointers to objects.	02
6.	Write a program for pointers to pointers, this pointer.	02
7.	Write a program for Templates, Exception handling.	02
8.	Write a program for Stack and Queue.	02
9.	Write a program for the linked list,	02
10.	Write a program for Binary tree, Traversal of a Binary tree.	02

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV					
Course Code	IKS221					
Course Category	Indian Knowledge Systems					
Course title	**Introduction to Performing Arts**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	01	-	-	01		01
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		50	-	50
Course Rationale:	The course "Introduction to Performing Arts" seeks to broaden the horizons of engineering students by integrating the rich and diverse realm of performing arts into their curriculum. By exploring various performing arts forms, students will not only develop a deeper understanding of human expression but also enhance their creativity, communication skills, and cultural awareness. This interdisciplinary approach aligns with NEP 2020's vision of holistic education and fosters the development of well-rounded individuals equipped to thrive in a rapidly evolving world.					
Course Objectives	The Course is aimed to- 1. Introduce fundamental concepts, history, and theoretical frameworks of various performing arts forms. 2. Cultivate appreciation for cultural, social, and aesthetic dimensions of performing arts. 3. Develop critical thinking and analytical skills through performance analysis. 4. Enhance communication and presentation skills through practical exercises. 5. Foster creativity and imagination through exploration of diverse performing arts mediums.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Identify and analyze key elements and techniques across theater, dance, music, and visual arts. 2. Demonstrate understanding of historical, cultural, and social contexts in performing arts. 3. Critically evaluate performances using appropriate terminology. 4. Apply performance principles to effectively communicate ideas and emotions. 5. Engage in creative expression through original performances.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	3	2	2		2		2								
CO2						3	2								
CO3							2		3	3					
CO4						2		2	3	3					

CO5											3				

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	**Foundations of Performing Arts** • Introduction to Performing Arts: Definition, scope, and significance. • Historical overview: Evolution of performing arts across cultures and civilizations.	2
II	**Theatrical Arts** • Introduction to theater: Origins, elements, and dramatic conventions. • Major theatrical movements and styles: Realism, surrealism, absurdism, etc. • Analysis of selected plays and playwrights.	3
III	**Dance Forms** • Introduction to dance: Styles, techniques, and cultural contexts. • Exploration of classical, folk, and contemporary dance forms. • Practical exercises and choreography workshops.	3
IV	**Musical Expressions** • Introduction to music: Basic principles, genres, and traditions. • Appreciation of classical, folk, and popular music styles. • Analysis of musical compositions and performances.	2
V	**Visual Performing Arts** • Introduction to visual arts in performance: Set design, costume, and makeup. • Role of visual elements in enhancing the theatrical experience. • Case studies and practical demonstrations.	2
VI	**Performance and Presentation** • Practical application of performing arts principles: Group performances and presentations. • Rehearsal techniques, stage presence, and audience engagement. • Reflection and feedback on individual and group performances.	2
	Reference Books	
i)	Bharata Muni, *Natyashastra*, An ancient Indian treatise on performing arts covering various aspects of classical dance, music, and drama, composed between 200 BCE and 200 CE, influencing the theory and practice of Indian performing arts for centuries.	
ii)	Girish Karnad. (2005). Collected Plays: Volume 1. Oxford University Press.	

iii)	Mohan Khokar. (2000). Traditions of Indian Classical Dance. Clarion Books
iv)	Sunil Kothari. (2001). Kathak, Indian Classical Dance Art. Abhinav Publications.
v)	Sangeet Natak Akademi. (2005). Indian Music: Tradition and Trends. Sangeet Natak Akademi.
vi)	P. Sambamurthy. (2010). South Indian Music, Vol. 1. The Indian Music Publishing House.
vii)	Kapila Vatsyayan. (2007). Indian Classical Dance: Tradition in Transition. Publications Division, Ministry of Information and Broadcasting, Government of India.
viii)	Vijay Tendulkar. (2010). Collected Plays in Translation. Oxford University Press.

Useful Links

i)	https://www.youtube.com/watch?v=W7bEzgZrN7s
ii)	https://www.youtube.com/watch?v=DQbNpx_CfJY
iii)	https://www.youtube.com/watch?v=eGiz50aVYWQ

Assessment

For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure comprehensive assessment of the students' performance. Following Evaluation Components are suggested:

- Written Assignments: 20 Marks
- Practical Assessments: 20 Marks
- Class Participation and Engagement: 10 Marks

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV			
Course Code	MAC 221			
Course Category	Mandatory Audit Course			
Course title	**Aptitude Enhancement Course I**			
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**
	-	01	-	01
Evaluation Scheme	IE at Course in charge end			
Course Rationale	This Aptitude Enhancement Course I aims to nurture holistic development among second-year B. Tech. Engineering students by focusing on enhancing their critical thinking, problem-solving skills, creativity, and emotional intelligence. Aligned with the NEP 2020 and Outcome-Based Education (OBE) philosophy, the course seeks to empower students with essential aptitudes required for success in both academic and professional domains.			
Course Objectives	The Course is aimed to- 1. Equip students with critical thinking skills through analytical exercises and problem-solving tasks. 2. Foster creativity and innovation by engaging students in structured workshops and practical projects. 3. Develop students' emotional intelligence through self-awareness activities and stress management techniques. 4. Enhance collaborative skills and effective communication through group discussions and team-based projects.			
Course Outcomes	Upon completion of this course, student should be able to – 1. Demonstrate proficiency in critical thinking by analysing complex problems and proposing effective solutions. 2. Exhibit creativity through the development of innovative projects and solutions. 3. Display heightened emotional intelligence by managing stress, communicating empathetically, and resolving conflicts constructively. 4. Showcase collaborative skills by actively participating in group activities, contributing to team goals, and communicating ideas effectively.			

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1		3		3						2					
CO2		2			2	1									
CO3						3	2	3							
CO4									3	3	2	1			

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	Inter-Personal & Inter-Organisational Communication	2
II	Creative & Critical Thinking	2
III	Group Dynamics & Decision-Making Techniques	2
IV	Emotional Intelligence & Stress Management	3
V	Assessment	5

Reference Books

i)	Chakravarthi T. Kalyana and Chakravarthi T. Latha, *Soft Skills for Managers* (Biztantra Publications, 2014 (ISBN: 978-81-7722-568-6))
ii)	Kumar Sanjay and Pushp Lata (2015), *Communication Skills*, 2nd Edition, Oxford University Press, (ISBN: 9780199457069)
iii)	P. D. Chaturvedi and Mukesh Chaturvedi (2017), *The Art and Science of Business Communication-Skills, Concepts, Cases and Applications*, 4th Edition, Pearson India Education Services Pvt. Ltd., (ISBN 978-93-325-8728-1)
iv)	Wright, L. (2001). Critical Thinking: An Introduction to Analytical Reading and Reasoning. Oxford University Press.
v)	Kallet, M. (2014). Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills. Wiley.
vi)	Bradberry, T., & Greaves, J. (2009). Emotional Intelligence 2.0. TalentSmart.
vii)	Dweck, C. S. (2007). Mindset: The New Psychology of Success. Ballantine Books.

Assessment

For the internal assessment of the course, with a total evaluation is of 50 marks. Combination of different evaluation methods can be utilized to ensure comprehensive assessment of the students' performance. The assessment will focus real-world scenarios that require the application of critical thinking, problem-solving, creativity, emotional intelligence, and teamwork. Following Evaluation Components are suggested:

1. Activity 1- Group Presentation (20 marks)
2. Activity 2- Group Discussion (20 marks)
3. Classroom Participation and Engagement (10 marks)
   Active participation in class discussions, group activities and question-answer sessions.

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV			
Course Code	PBL221			
Course Category	Project Based Learning			
Course title	**Mini Project II**			
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**
	-	01	-	01
Evaluation Scheme	IE at Course in charge end			
Pre-requisites(if any)	Basics of Programming Language and Computers			
Course Objectives	The Course is aimed to- 1. Create awareness among the students to express technical ideas, strategies and methodologies in written form. 2. Enable students to work as a responsible member and possibly a leader of a team in developing software solutions. 3. Motivate students to self-learn new tools, algorithms, and/or techniques that contribute to the software solution of the project 4. . Create awareness among the students of the characteristics of several domain areas where IT can be effectively used. 5. Improve the team building, communication and management skills of the students 6. Enable students to develop a design solution for a set of requirements			
Course Outcomes	Upon completion of this course, student should be able to – 1. Acquire practical knowledge within the chosen area of technology for project development 2. Identify, analyze and handle programming projects with a comprehensive and systematic approach 3. Contribute as an individual or in a team in development of technical projects 4. Develop effective communication skills for presentation of project related activities 5. Formulate and propose a plan for creating a solution for the problem identified 6. Report and present the findings of the study conducted in the preferred domain			

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1		2	2												
CO2		2	2	2											
CO3									2	2					
CO4							2								
CO5						2									
CO6											2	2			

Level of Mapping as: Low 1, Moderate 2, High

Course Content
Mini Project II is a continuation of the experiential learning journey initiated in Semester III. Building upon the foundations laid in Mini Project I , students will delve deeper into project activities related to their chosen area of interest within Computer Science and Technology. The course encompasses following component: 1. Mini Project II: Students will continue their project activities from the preceding semester, further refining their research objectives, conducting experiments, analyzing data, and presenting findings. Emphasis will be placed on applying advanced concepts and techniques to address specific challenges or opportunities identified in the chosen project area. The course will be conducted over the duration of one tutorial hour per week, with additional time allocated for project work as necessary. Assessment will be based on project presentations, reports, evaluating students' understanding, application, and integration of theoretical and practical knowledge. The mini-project should be undertaken preferably by a group of 3 students who will jointly work and implement the mini-project. The group will select a project with the approval of the guide. A batch of practical / Tutorial will be divided into mini project groups. Mini project topics and the work for these groups in the batch will be guided by a teacher for the batch, preferably on one of the topics like Compiler Construction, Database Engineering, Operating System, Computer Graphics and Multimedia, Advanced Programming and latest developments and trends in Computer Science and Technology. The teacher will periodically assess the performance of individual student in the mini project, jointly with a teacher of another batch. Project group will submit hardcopy project report along with project demonstration software in CD and/or project hardware gadget at the term end. The IOE of mini project will be jointly conducted by appointed examiners. Note: Use of Open source tools should be preferred.
Course Assessment Process
The course assessment process will be similar to that mentioned under Mini Project I.

Year, Program, Semester	S.Y. B.Tech (Computer Science and Technology) , Part II, Semester IV				
Course Code	HSMEC221				
Course Category	Humanities, Social Science, Management Environment				
Course title	**Environmental Studies**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	02	-	-	02	00
Evaluation Scheme	Even Semester End Exam: 70 marks , Project/Visit based IOE: 30 Marks				
Pre-requisites (if any)	HSMEC 211				
Course Rationale	The Course is all about learning the way we should live and how we can develop sustainable strategies to protect the environment. It helps individuals to develop an understanding of living and physical environment and how to resolve challenging environmental issues affecting nature.				
Course Objectives	The course teacher will ensure to 1. Describe the various types and sources of environmental pollution. 2. Explore other global environmental issues, such as biodiversity loss, deforestation, and ocean acidification. 3. Explain key environmental laws and regulations at the national and international levels. 4. Explain the relationship between human society and the environment.				
Course Outcomes	Upon completion of this course, student should be able to 1. Classify different types of environmental pollutants and their sources. 2. Analyse the interconnections between climate change and other global environmental issues. 3. Understand the legal frameworks and regulations governing environmental protection and management. 4. Describe the socio-economic drivers of environmental degradation and inequality.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	3	3	-	-	-	-	3	3	-	-	-	-			
CO2	-	3	3	3	-	-	3	3	3	2	-	-			
CO3	-	2	3	3	-	-	3	3	3	3	-	-			
CO4	-	2	-	-	-	-	3	3	3	3	-	-			

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I.	**Environmental Pollution:** Definition: Causes, effects and control measures of: a) Air pollution, b) Water pollution, c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution, g) Nuclear hazards and their effects. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution	**07**

II.	**Understanding climate change and other global environmental issues:** -Structure of atmosphere; greenhouse gas emissions; Projections of global climate change, Importance of 1.5 °C and 2.0 °C limits to global warming; Carbon foot print, -Impacts of climate change: on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; -Mitigation of climate change: Green House Gas (GHG) reduction, sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policies for mitigation, net zero targets for the future; Energy efficiency measures; Renewable energy sources for carbon reduction; Carbon capture and storage, - Acid Rain: Causes, effects and mitigation - Ozone Layer Depletion: Causes, effects and mitigation.	**08**
III.	**Environmental legislation:** Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g), Environmental Protection Act., Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act	**06**
IV.	**Social Environment:** Environmental ethics, Environmental movements- Chipko Movement, Appiko Movement, Silent Valley Movement. Water conservation: rain water harvesting, watershed management, Disaster management: floods, earthquake, cyclone, tsunami and landslides.	**04**
	Nature Visits / Field Work /Field Tour/ Industrial visits / Activities related to Campus environmental management (5 Hrs.)	**05**

Text Books

1.	Agarwal, K. C. (2001), Environmental Biology, Nidi Publ. Ltd., Bikaner.
2.	Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad, 380013, India.
3.	Brunner R. C., (1989), Hazardous Waste Incineration, McGraw Hill Inc. 480p.

Reference Books

1.	Cunningham, W. P. Cooper, T. H. Gorhani, E. & Hepworth, M. T.,(2001), Environmental Encyclopedia, Jaico Publ. House, Mumbai.
2.	Gleick, H., (1993), Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press 473p.
3.	Hawkins R. e., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
4.	Heywood, V. H. & Watson, R. T., (1995), Global Biodiversity Assessment, Cambridge Univ. Press.
5.	Jadhav, H. & Bhosale, V. M., (1995), Environmental Protection and Laws, Himalaya Pub. House, Delhi, 284p.
6.	Mckinney, M. L. & Schocl. R. M., (1996), Environmental Science Systems & Solutions, Web enhanced edition.
7.	Miller T. G. Jr., Environmental Science, Wadsworth Publishing Co. (TB).
8.	Odum, E. P., (1971), Fundamentals of Ecology, W. B. Saunders Co. USA.
9.	Rao M. N. & Datta, A. K., (1987), Waste Water Treatment, Oxford & IBH Publ. Co. Pvt. Ltd.,
10.	Sharma B. K., (2001), Environmental Chemistry, Goel Publ. House, Meerut.
11.	Survey of the Environment, The Hindu (M).
12.	Trivedi R. K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media (R)
13.	Wagner K. D., (1998), Environmental Management, W. B. Saunders Co. Philadelphia, USA.

Equivalence for the curriculum revision at B. Tech Computer Science and Technology

The above syllabus structure is a revised version of the Second Year B. Tech (Computer Science and Technology) Program being conducted by Shivaji University at its Technology Department. A special mention rather feature of this revision is, ***it is in line with New National Education Policy 2020 guidelines.*** This syllabus is to be implemented from June 2024, (Academic year 2024-25).

The Equivalence for the Courses of Computer Science and Technology at Second Year B Tech Semester III and IV pre-revised Program under the faculty of Science and Technology is as follows.

Semester III

Sr. No.	Second Year B. Tech Semester III Pre-revised syllabus	Second Year B. Tech Semester III Revised syllabus	Remark
1	Applied Mathematics-I	Applied Mathematics- I	Content is revised
2	Discrete Mathematical Structure	Discrete Mathematical Structure	No change in the subject content
3	Digital System and Microprocessor	Digital System and Microprocessor	No change in the subject content
4	Data Structures	Data Structures	No change in the subject content
5	Data Communication and Networking	Data Communication and Networking	No change in the subject content
6	Digital System and Microprocessor Lab	Digital System and Microprocessor Lab	No change in the subject content
7	Data Structures Lab	Data Structures Lab	No change in the subject content
8	Data Communication and Networking Lab	Data Communication and Networking Lab	No change in the subject content
9	Environmental Studies	Environmental Studies	Modified as per University suggested content. But there are no credits. The evaluation is at the end of Even Semester.
10	Soft Skills Development	Soft Skills Development	Content is revised and made it as a Credit course
11	------	Mini Project I	Newly

			introduced audit course.
12	Introduction to Performing Arts	------	Shifted to Sem IV

Semester IV

Sr. No.	Second Year B. Tech Semester IV Pre-revised syllabus	Second Year B. Tech Semester IV Revised syllabus	Remark
1	Theory of Computation	Theory of Computation	No change in the subject content
2	Advanced Microprocessor	Advanced Microprocessor	No change in the subject content
3	Computer Organization	Computer Organization	No change in the subject content
4	Software Engineering	Software Engineering	No change in the subject content
5	Applied Mathematics-II	Applied Mathematics-II	No change in the subject content
6	Advanced Microprocessor Lab	Advanced Microprocessor Lab	No change in the subject content
7	Linux and Shell Programming Lab	Linux and Shell Programming Lab	No change in the subject content
8	Object Oriented Programming Lab	Object Oriented Programming Lab	No change in the subject content
9	Environmental Studies Project Work	Environmental Studies	No change in the subject content. Only change in Title.
10	Soft Skills Development	------	Shifted to Sem III
11	-	Multidisciplinary Minor Course I	As per NEP feature, MDM is introduced.
12	------	Aptitude Enhancement Course -I	Newly introduced
13	------	Mini Project II	Newly introduced
14	------	Introduction to Performing Arts	Made it as a Credit course with content revision.

Shivaji University Vidyanagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Pool of Multidisciplinary Minors for MDM Featured B. Tech (Computer Science and Technology), Detailed Curriculum

Multidisciplinary Minor
In
Embedded Systems

For
B.Tech (Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Embedded Systems

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	MDM 1.1	MCS-51 Microcontroller Architecture and Programming	03	-	-	03	03	30:70	00:00
2.		MDM 1.2	PIC Microcontroller Architecture and Programming	03	-	-	03	03	30:70	00:00
3.		MDM 1.3	ARM and Embedded systems	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 1.4	Internship	One Month				03	-	50:50
5.	Project Based Learning	MDM 1.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	14	300	200
			Total Hours	**09**	**00**	**00**	**09**	-	-	-

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor I: Embedded Systems

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 1.1				
Course Category	Minor Program Core				
Course title	**MCS-51 Microcontroller Architecture and Programming**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics				
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems.				
Course Objectives	The students will learn 1. Basics of processors 2. Architecture of MCS-51 family 3. MCS-51 Instruction set and assembly language programming 4. Embedded C programming 5. Peripheral interfacing and programming 6. Perform laboratory work or minor project				
Course Outcomes	The students will be able to 1. Classify between microcontrollers and microprocessors 2. Describe the architecture of MCS-51 family 3. Illustrate the MCS-51 Instruction set and perform assembly language programming 4. Perform embedded C language programming 5. Interface peripherals and control through programming 6. Complete laboratory work and minor project				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								
CO 5	3	3		1								
CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Microprocessors and microcontroller** Evolution of microprocessors & microcontrollers, microprocessors v/s microcontrollers 8/16/32 bit processors & controllers, CISC v/s RISC architectures, registers, memory & types of memory, bus, interrupts	06
2.	**MCS-51 Microcontroller family** Introduction to MCS-51 architecture, 8051 microcontroller hardware, Input /output pins, external memory, register files, counters and timers, interrupts, serial communication, development tools IDE	06
3.	**Instruction set and assembly language programming** Addressing modes, instruction set of 8051 microcontroller, assembly language programs	06
4.	**Embedded C programming** Comparison of assembly and embedded c language programming, data types, variables, operators, storage classes, arrays, strings, C language programming for 8051 microcontroller	06
5.	**MCS-51 Microcontroller interfacing and programming** Interfacing of LEDs, DC motors, stepper motors, buzzers, switches, matrix keyboards, seven segment displays, LCD displays, ADC, DAC, relays, thumbwheel , interfacing I^2C,SPI bus devices,RS232	06
6.	**Laboratory work / minor project work** 8051 microcontroller based minor project : concept to implementation or the laboratory work based on syllabus	06

Sr. No.	Reference Books
1.	Kenneth Ayala, "The 8051 Microcontroller Architecture, programming and Applications" Penram Intrnational
2.	Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded systems" Pearson Education Asia LPE
3.	Ajay Deshmukh, " Microcontrollers: Theory and applications ", Tata McGraw hill edition
4.	Intel or Atmel MCS 51 Family Microcontrollers Data Sheets
5.	Mike Predcko "8051 Microcontrollers programming and practice"
Sr. No.	**Important web links**
1.	Relevant to the course matter

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 1.2				
Course Category	Minor Program Core				
Course title	**PIC Microcontroller Architecture and Programming**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics				
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems.				

Course Objectives	The students will learn 1. Basics of CISC and RISC architectures 2. Architecture of PIC 16F8XX microcontroller 3. PIC 16F8XX Instruction set and assembly language programming 4. Embedded C programming 5. Peripheral interfacing and programming 6. Perform laboratory work or minor project
Course Outcomes	The students will be able to 1. Classify between CISC and RISC architectures 2. Describe the architecture of PIC 16F8XX family 3. Illustrate the PIC 16F8XX architectures Instruction set and perform assembly language programming 4. Perform embedded C language programming 5. Interface peripherals and control through programming 6. Complete laboratory work and minor project

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								
CO 5	3	3		1								
CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**CISC and RISC microcontrollers** CISC v/s RISC microcontrollers, architecture of CISC and RISC microcontrollers, Von-Neumann and Harvard architecture	06
2	**PIC Microcontroller family** PIC 16F877 microcontroller architecture, 16F877 microcontroller hardware, Input /output pins, external memory, register files, counters and timers, interrupts, serial communication	06
3	**Instruction set and assembly language programming** Addressing modes, instruction set of PIC16F8XX microcontroller, assembly language programs	06
4	**Embedded C programming** Comparison of assembly and embedded c language programming, data types, variables, operators, storage classes, arrays, strings, C language programming for PIC 16F8XX microcontroller	06
5	**PIC 16F8XX Microcontroller interfacing and programming** Interfacing of LEDs, DC motors, stepper motors, buzzers, switches, matrix keyboards, seven segment displays, LCD displays, ADC, DAC, relays, thumbwheel , interfacing I^2C,SPI bus devices, RS232	06

6	**Laboratory work / minor project work** PIC 16F8XX microcontroller based minor project : concept to implementation or the laboratory work based on syllabus	**06**

Sr. No.	**Reference Books**
1	Microchip PIC 16F877 family Microcontrollers Data sheet
2	John B. Peatman, "Design with PIC Microcontrollers " Pearson Education Asia. LPE
Sr. No.	**Important web links**
1	Relevant to the course matter

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 1.3				
Course Category	Minor Program Core				
Course title	**ARM and Embedded systems**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics				
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems.				
Course Objectives	The students will learn 1. 32 bit microcontroller 2. Architecture of ARM7TDMI microcontroller 3. ARM7TDMI Instruction set and assembly language programming 4. Embedded C programming 5. Peripheral interfacing and programming 6. Perform laboratory work or minor project				
Course Outcomes	The students will be able to 1. Classify between 8/16/32 bit microcontrollers 2. Describe the architecture of ARM7TDMI family 3. Illustrate the ARM7TDMI architectures Instruction set and perform assembly language programming 4. Perform embedded C language programming 5. Interface peripherals and control through programming 6. Complete laboratory work and minor project				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								
CO 5	3	3		1								
CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**INTRODUCTION TO ARM ARCHITECTURE** ARM7TDMI architecture, registers, interrupts, exception process, status registers processor modes, memory, memory mapped I/O, endianness	06
2	**ARM INSTRUCTION SET** ARM instruction set: Data processing instruction, Load, store, Branch, interrupt instruction, program status register instruction, loading constants, conditional execution	06
3	**THE THUMB INSTRUCTION SET** Entering thumb state, Thumb instruction set: Thumb register usage, ARM Thumb Interworking, branch instructions, Data processing, single register load-store, multiple register load-stores, stack instructions, software interrupt instruction	06
4	**INTERRUPTS and MEMORY MANAGEMENT UNIT** Interrupts and exception handling schemes, Memory architecture, Memory access sequence, translation process, access permissions, domains, Aborts	06
5	**EMBEDDED SYSTEMS** Introduction, CISC and RISC architectures, features of 8/16/32 bit microcontrollers, device drivers, Interrupt servicing mechanisms, programming concepts in embedded C and C++, Prototype development phases, software design and implementation , Hardware software co design, Case study: Adaptive cruise control system in car.	06
6	**Laboratory work / minor project work** ARM microcontroller based minor project : concept to implementation or the laboratory work based on syllabus	06

Sr. No.	Reference Books
1	ARM architecture reference manual
2	Sloss, Symes, Wright, “ARM system developers guide” Morgan Kaufman, Elsevier, publication
3	Raj Kamal, "Embedded Systems: Architecture, Programming and Design", TMH, 2003.
4	Wolf, Wayne, "Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001

5	Vahid, Frank and Givargi, Tony, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley & Sons, New York, 2000.
6	Deshmukh, Ajay V., "Microcontroller Theory and Applications", Tata McGraw-Hill.
7	ARM7TDMI manual
8	Philips LPC 2148 manual
Sr. No.	**Important web links**
1	Relevant to the course matter

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 1.4						
Course Category	Program Based Internship						
Course title	**Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	One Month					03	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics, microcontrollers						
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts Embedded systems. It aims to equip students with the foundational knowledge and skills necessary to program and design the embedded systems.						
Course Objectives	The students will learn 1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions 2. To have hands on experience in the related field to get exposure with the industrial trend 3. To promote cooperation and to develop synergetic collaboration between industry and the university 4. To set the step for future recruitment 5. Get familiarity with professional skills 6. Understand the information required for entrepreneurship						
Course Outcomes	The students will be able to 1. Know the industrial working environment 2. Utilize the technical resources 3. Write technical documents and appear for interview / power point presentations/ technical discussions 4. Develop attitude of a team player and ability of life-long learning 5. Adapt and develop professional skills required for employability 6. Motivation for entrepreneurship						

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1							3	
CO 2	3	2	3	3							3	
CO 3	3	2	3	3	3						3	
CO 4	3	1	3	3							3	
CO 5	3	3		1							3	
CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2						1	
PSO2	2	3	1	3	2						2	

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	**Course Content**	**Duration**
1	One Month(Four-week) industrial training in a reputed industry from stand point view of Embedded systems - electronics engineering is mandatory. Students should learn and understand the concepts of system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student.	**4 week**
Sr. No.	**Reference Books**	
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports	
2	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.	
Sr. No.	**Important web links**	
1	As per requirement	

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards							
Course Code	MDM 1.5							
Course Category	Project Based Learning							
Course Title	**Mini Project**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	-	-	-	-		02		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.							
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in the Industry.							
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.							
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.							

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:
Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Multidisciplinary Minor
In
Industrial Robotics

For
B.Tech (Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Industrial Robotics

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	MDM 2.1	Introduction to Robotics	03	-	-	03	03	30:70	00:00
2.		MDM 2.2	Microprocessor & Embedded Systems	03	-	-	03	03	30:70	00:00
3.		MDM 2.3	Control of Robotic Systems	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 2.4	Internship	One Month			-	03	-	50:50
5.	Project Based Learning	MDM 2.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	**-**	**-**	**-**

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor II: Industrial Robotics

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 2.1				
Course Category	Minor Program Core				
Course title	**Introduction to Robotics**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Basic understanding of mathematics, physics, control system, programming skills and problem-solving skills.				
Course Rationale	This course acquaints students with fundamental principles, technologies, and interdisciplinary skills necessary to comprehend, design, and program robotic systems, equipping them for careers in domains shaped by automation and technological advancement. It aims to cultivate problem-solving abilities, promote STEM education, and address ethical considerations surrounding the deployment of robotic technologies in diverse societal contexts.				
Course Objectives	Teachers will be able to: 1. Introduce students to the basic concepts and principles of robotics. 2. Enhance the knowledge of students of grippers and sensors in Robots. 3. Establish knowledge of drives, actuators and control system in Robotics. 4. Provide students with the skills to program robots using programming languages such as VAL, RAIL, AML, Python, ROS. 5. Introduce Socio-Economic aspect, Safety for robot and new trends in Robotics. 6. Enhance knowledge of advanced techniques in Robotics.				
Course Outcomes	Students will be able to: 1. Express his views as per terminologies related to Robotics technology. 2. Classify and apply different grippers and sensors foe various applications in Robotics. 3. Apply knowledge of drives and actuators in Robotics. 4. Apply programming language in robots. 5. Understand the socio-economic aspect for Robot. 6. Understand ways to update knowledge in the required area of robotic technology.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								
CO 5	3	3		1								
CO 6	3	2	3	3	3							3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Introduction to robotics** Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.	**06**
2.	**Grippers and Sensors for Robotics** Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	**06**
3.	**Drives and Control for Robotics** Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control	**06**
4.	**Programming and Languages for Robotics** Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.	**06**
5.	**Related Topics in Robotics** Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.	**06**
6.	**Advanced Robotic Systems and Emerging Technologies** Advanced Robotic Systems: Surgical Robots, Autonomous Vehicles, Swarm Robotics, Exoskeletons Emerging Technologies: Machine Learning, Deep Learning, Neural Networks, Reinforcement Learning, Human-Robot Interaction: Cognitive Robotics, Emotion Recognition, Natural Language Processing, Bio-inspired Robotics, Ethical Considerations in Robotics, Future Trends and Speculations.	**06**

Sr. No.	Text/ Reference Books
1.	S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2.	Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3.	Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)
4.	R. K. Mittal, I. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi (2003)
5.	S. B. Niku, Introduction to Robotics – Analysis, Contro, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
6.	J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997)
7.	Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
8.	R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)
Sr. No.	**Important web links**
1.	https://nptel.ac.in/courses/107106090
2.	https://onlinecourses.nptel.ac.in/noc21_ee32/preview

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 2.2				
Course Category	Minor Program Core				
Course title	**Microprocessor & Embedded Systems**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Prerequisites: Understanding of digital electronics, basic programming concepts, and familiarity with fundamental electrical circuits. Proficiency in programming languages such as C/C++ is highly recommended, along with prior exposure to microcontroller architectures and operating principles. Additionally, a foundational understanding of robotics principles, including sensors, actuators, and control systems, would be beneficial for students to effectively engage with the course material.				
Course Rationale	The course provides students with the theoretical knowledge and practical skills required to understand, design, and implement embedded systems solutions tailored specifically for the intricacies of robotic applications.				
Course Objectives	1. Understand the fundamental principles of microprocessors and microcontroller architectures. 2. Learn about the role of embedded systems in robotics and their applications in real-world scenarios. 3. Explore interfacing techniques between microcontrollers and various sensors, actuators, and peripherals commonly used in robotics. 4. Develop skills in designing and implementing embedded systems solutions for robotic control, including motor control, sensor data processing, and communication protocols. 5. Explore emerging trends and technologies in the field of microprocessor and embedded systems for robotics, such as edge computing, machine learning inference on embedded devices, and Internet of Things (IoT) integration.				
Course Outcomes	Students will be able to: 1. Describe the block diagram of embedded systems and identify trends in the embedded industry. 2. Identify the pin configuration and functions of the 8086 Microprocessor. 3. Learn about memory interfacing and programmable peripheral interfacing. 4. Understand the applications of microcontroller interfacing through case studies. 5. Gain proficiency in embedded C programming for advanced embedded processors. 6. Gain practical experience in data acquisition using both microprocessors and microcontrollers.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								

CO 5	3	3		1								
CO 6	3	2	3	3	3							3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Introduction to Embedded Systems and microcomputers** Introduction to Embedded Systems, Embedded System Applications, Block diagram of embedded systems, Trends in Embedded Industry, Basic Embedded System Models, Embedded System development cycle, Challenges for Embedded System Design, Evolution of computing systems and applications. Basic Computer architecture: Von-Neumann and Harvard Architecture. Basics on Computer organizations. Computing performance, Throughput and Latency, Basic high performance CPU architectures, Microcomputer applications to Embedded systems and Mechatronics. Sensors and sensing mechanisms	**08**
2	**Microprocessor and Microcontrollers** Basics of microprocessor and microcontrollers, CISC v/s RISC architecture , 8051 architecture and assembly and C language programming.	**06**
3	**Microprocessor Interfacing:** Introduction to interfacing, Memory Interfacing, Programmable Peripheral Interfacing, Programmable I/O, Programmable Interrupt Controller, Programmable Timers, Programmable DMA Controller, Programmable Key Board Controller, Data acquisition Interfacing: ADC, DAC, Serial and parallel data Communication interfacing. Microcontroller: Introduction to Microcontroller and its families, Criteria for Choosing Microcontroller. Microcontroller Architecture, programming model, addressing modes, Instruction sets, Assembly and C programming for Microcontroller, I/O programming using assembly and C language, Interrupt Controller, I/O interfacing, Timers, Real Time Clock, Serial and parallel Communication protocols, SPI Controllers. LCD Controller.	**08**
4	**Microcontroller Interfacing** Introduction to Microcontroller Interfacing and applications: case studies: Display Devices, controllers and Drivers for DC, Servo and Stepper Motor.	**04**
5	**Introduction to Advanced Embedded Processor and Software** ARM Processor, Unified Model Language (UML), Embedded OS, Real Time Operating System (RTOS), Embedded C.	**04**

6	**Microprocessor and Embedded System Laboratories:** Basic C language programming implementation on Microprocessor and Microcontroller. Interfacing Displays, Key boards and sensors with Microprocessors and Microcontrollers, Data Acquisition using Microprocessor and Microcontroller, Implementation of Controlling schemes for DC, Servo, Stepper motor using C programming in microprocessors and Microcontrollers.	**06**

Sr. No.	**Text/Reference Books**
1	K. V. Shibu, Introduction to Embedded Systems, McGRAW Hill Publications (2009).
2	Raj Kamal, Embedded Systems, TATA McGRAW Hill Publications (2003).
3	M. Morris Mano, Computer System Architecture, 3ed, Pearson Publication, (2007).
4	M. A. Mazidi, , 8051 Microcontrollers and Embedded Systems, Pearson Publications, (2008).
5	B. B. Brey, The Intel Microprocessors, Prentice Hall Publications, 8th ed, (2018).
6	M. A. Mazidi, R.D. Mckinlay and D. Casey, PIC Microcontrollers and Embedded Systems, Pearson Publications, (2008).
7	M. Predko, Programming and Customizing the PIC Microcontroller, McGRAW Hill Publications. 3ed, (2017).
8	R. Barnett, L. O'Cull and S. Cox, Embedded C Programming and Microchip PIC, Cengage Learning, (2003).
Sr. No.	**Important web links**
1	https://nptel.ac.in/courses/108102045
2	https://onlinecourses.nptel.ac.in/noc22_ee12/preview

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 2.3				
Course Category	Minor Program Core				
Course title	**Control of Robotic Systems**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Prerequisites: A solid understanding of robotics principles, encompassing kinematics, dynamics, and robot modeling. Proficiency in mathematical concepts such as calculus, linear algebra, and differential equations				
Course Rationale	The course equips students with the theoretical foundations and practical skills necessary to design, analyze, and implement advanced control strategies for enhancing the performance and autonomy of robotic systems in diverse applications.				
Course Objectives	Teachers will be able to: 1. Introduce basic concepts of control systems. 2. Explain proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) controllers. 3. Explain design of controllers for non-linear systems using describing function method. 4. Explain the design of force control and hybrid position/force control systems for robotic applications. 5. Enhance knowledge of students about Utilizing sensing and perception for closed-loop control in robotic systems. 6. Integrate machine learning and artificial intelligence methods for autonomous robotic control.				
Course Outcomes	Students will be able to: 1. Interpret Bode, polar, and Nyquist plots for frequency domain analysis. 2. Implement proportional (P), proportional-integral (PI), and proportional-integral-derivative (PID) controllers. 3. Identify common physical non-linear systems and their characteristics. 4. Design force control and hybrid position/force control systems for robotic applications. 5. Integrate multiple sensor modalities using sensor fusion techniques. **6.** Explore advanced control techniques including adaptive control and robust control.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1								
CO 2	3	2	3	3								
CO 3	3	2	3	3	3							
CO 4	3	1	3	3								

CO 5	3	3		1								
CO 6	3	2	3	3	3							3
PSO1	3	3	3	3	2							
PSO2	2	3	1	3	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**Basics of Control** Differential Equation, Transfer function, Frequency response, Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design, Bode, polar, Nyquist plot.	06
2	**Linear Control** Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, P, PI & PID Controller, control law partitioning, modelling and control of a single joint.	06
3	**Non-Linear Control System** Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, the control problems for manipulators.	06
4	**Motion Control** Point to Point Control, trajectory generation, Continuous Path Control, Joint based control, Cartesian Control, Force Control, hybrid position/force control system.	06
5	**Sensing and Perception for Robotic Control** Overview of sensors and perception systems used in robotics Sensor fusion techniques for integrating multiple sensor modalities Applications of sensing and perception in closed-loop control of robotic systems.	06
6	**Advanced Topics in Robotic Control** Exploration of advanced control techniques such as adaptive control and robust control Integration of machine learning and artificial intelligence for autonomous robotic control Case studies and practical examples demonstrating the application of advanced control methods in robotics.	06

Sr. No.	Reference Books
1	M. Gopal, Control Systems, McGraw-Hill (2012)
2	K. Ogata, "Modern Control Engineering", Prentice Hall India (2009).
3	M. Spong, M. Vidyasagar, S. Hutchinson, Robot Modeling and Control, Wiley & Sons, (2005).
4	J. J. Craig, "Introduction to Robotics: Mechanics and Control", 3rd edition, Addison-Wesley (2003).
5	S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014).
6	Thomas Kailath, "Linear Systems", Prentice Hall (1980).
7	Alok Sinha, "Linear Systems: Optimal and Robust Control", Taylor & Francis (2007).
Sr. No.	**Important web links**
1	https://onlinecourses.nptel.ac.in/noc24_me18/preview

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 2.4						
Course Category	Program Based Internship						
Course title	**Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	One Month					03	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics, microcontrollers ,Programming						
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts of Robotics. It aims to equip students with the foundational knowledge and skills necessary to program and design the Robotic systems.						
Course Objectives	The students will learn 1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions 2. To have hands on experience in the related field to get exposure with the industrial trend 3. To promote cooperation and to develop synergetic collaboration between industry and the university 4. To set the step for future recruitment 5. Get familiarity with professional skills 6. Understand the information required for entrepreneurship						
Course Outcomes	The students will be able to 1. Know the industrial working environment 2. Utilize the technical resources 3. Write technical documents and appear for interview / power point presentations/ technical discussions 4. Develop attitude of a team player and ability of life-long learning 5. Adapt and develop professional skills required for employability 6. Motivation for entrepreneurship						

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1							3	
CO 2	3	2	3	3							3	
CO 3	3	2	3	3	3						3	
CO 4	3	1	3	3							3	

CO 5	3	3		1							3	
CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2						1	
PSO2	2	3	1	3	2						2	

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Duration
1	One Month (Four-week) industrial training in a reputed industry from stand point view of Robotic systems is mandatory. Students should learn and understand the concepts of system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student.	**4 week**
Sr. No.	**Reference Books**	
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports	
2	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.	
Sr. No.	**Important web links**	
1	As per requirement	

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 2.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for Industrial Robotics applications.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:
Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Multidisciplinary Minor
In
Internet of Things

For
B.Tech (Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Internet of Things

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	MDM 3.1	Introduction to Internet of Things	03	-	-	03	03	30:70	00:00
2.		MDM 3.2	Embedded Systems for IoT	03	-	-	03	03	30:70	00:00
3.		MDM 3.3	IoT with Arduino, ESP, and Raspberry Pi	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 3.4	Internship	One Month			-	03	-	50:50
5.	Project Based Learning	MDM 3.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	-	-	-

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor III: Internet of Things

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 3.1				
Course Category	Minor Program Core				
Course title	**Introduction to Internet of Things**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Knowledge of Embedded systems, microcontroller, computer networking				
Course Rationale	The Introduction to Internet of Things (IoT) course aims to provide students with a foundational understanding of the principles, technologies, and applications of the IoT. In the modern world, the proliferation of connected devices has become integral to various industries and daily life. This course is designed to equip students with the knowledge and skills necessary to comprehend, design, and implement IoT solutions. By exploring the fundamental concepts, architectures, and practical applications of IoT, students will be prepared to engage with the evolving landscape of connected systems.				
Course Objectives	1. To make students know the IoT ecosystem. 2. To provide an understanding of the technologies and the standards relating to the Internet of Things. 3. To develop skills on IoT technical planning. 4. To learn the basics of security and various types of security issues 5. To study different cryptography techniques available and various security attacks. 6. Explore network security and how they are implemented in real world.				
Course Outcomes	1. To understand the technology and standards relating to IoTs. 2. To understand the critical ecosystem required to mainstream IoTs. 3. To Acquire skills on developing their own national and enterprise level technical strategies. 4. Analyze and compare different IoT architectures and frameworks. 5. Select and configure appropriate sensors for specific IoT applications. 6. Identify and implement suitable communication protocols for IoT applications.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3											3	3
CO 2	3	3	2	1	1								3	
CO 3	3												3	2
CO 4	2												3	2
CO 5	1												2	3
CO 6	2												3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Introduction to Internet of Things:** IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	**06**
2.	**M2M to IoT –** A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	**06**
3.	**IoT Architecture -State of the Art –** Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views	**06**
4.	**IoT Applications for Value Creations** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry,	**06**
5.	**Internet of Things Privacy, Security and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	**06**
6.	**IoT application in different areas:** IOT for health application, IoT for Environment application	**06**

Sr. No.	Reference Books
1.	Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
2.	Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons.
3.	Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.
4.	Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media.
5.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
6.	Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.

Sr. No.	Important web links
1.	https://www.coursera.org/specializations/internet-of-things

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 3.2				
Course Category	Minor Program Core				
Course title	**Embedded Systems for IoT**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Knowledge of Embedded systems, microcontroller, computer networking				
Course Rationale	The proliferation of the Internet of Things (IoT) has led to an increased demand for professionals skilled in designing and developing embedded systems tailored for IoT applications. This course is designed to provide students with a deep understanding of embedded systems and their integration within the IoT ecosystem. It aims to equip students with the knowledge and skills necessary to design, program, and optimize embedded systems for efficient communication, data processing, and control in IoT environments.				
Course Objectives	1. To make students know the basic concept and architecture of embedded systems. 2. Different design platforms used for an embedded system for IoT applications. 3. To have knowledge about the IoT enabled technology.				
Course Outcomes	1. Understand the embedded system concepts and architecture of embedded systems. 2. Understand the different hardware/software co-design techniques for microcontroller-based embedded systems, apply techniques in IoT applications. 3. Understand and implement communication protocols suitable for IoT devices. 4. To be able to design web/cloud based IoT applications. 5. Design and implement interfaces for connecting sensors and actuators to embedded system 6. Identify and address security challenges specific to embedded systems in IoT.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3		2	2									3	3
CO 2	3			2									3	
CO 3	3		2											2
CO 4			3											2
CO 5			3		3									
CO 6					3								3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1.	**Purpose and requirement specification, IoT level specification**, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices.	06
2.	**Design of Embedded Systems:** Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture	06
3.	**Inputs and Outputs**: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).	06
4.	**IoT Enabling Technologies**: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots.	06
5.	**Web of Things and Cloud of Things**: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers,	06
6.	**Cloud Offerings and IoT Case Studies**: Introduction to Cloud Storage Models, Communication API.	06

Sr. No.	Reference Books
1.	RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
2.	Klaus Elk, “Embedded Software for the IoT”.
3.	Elizabeth Gootman et. al, “Designing Connected Products”, Shroff Publisher/O’Reilly Publisher.
4.	Perry Xiao, “Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed”.

Sr. No.	Important web links
1.	https://www.coursera.org/learn/iot

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards				
Course Code	MDM 3.3				
Course Category	Minor Program Core				
Course title	**IoT with Arduino, ESP, and Raspberry Pi**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE:30**			**ESE: 70**	**Total=100**
Pre-requisites (if any)	Knowledge of Embedded systems, microcontroller, computer networking				
Course Rationale	The Internet of Things (IoT) has become a pivotal aspect of modern technology, and understanding how to create IoT solutions using popular platforms like Arduino, ESP (Espressif), and Raspberry Pi is essential. This course is designed to provide students with hands-on experience in building IoT applications using these widely used hardware platforms. It aims to enable students to design, develop, and deploy IoT projects by combining hardware, software, and connectivity elements.				
Course Objectives	1. To give students hands-on experience using different IoT architectures. 2. To provide skills for interfacing sensors and actuators with different IoT architectures. 3. To develop skills on data collection and logging in the cloud.				
Course Outcomes	1. To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud. 2. To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration. 3. To solve analog sensor and digital sensor Interfacing with IOT devices. 4. Program ESP devices for IoT applications, including setting up wireless connectivity. 5. Use Raspberry Pi as an IoT gateway and implement data processing tasks. 6. Successfully integrate sensors and actuators with the chosen platforms to achieve specific IoT functionalities.				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3		2	2									3	3
CO 2	3			2									3	
CO 3	3		2											2
CO 4			3											2
CO 5			3		3									
CO 6					3								3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	**IoT- introduction and its components** IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).	06
2	**Arduino Uno – getting started with the Uno boards** blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module	06
3	**ESP 8266-12E Node MCU – getting started with the ESP board** Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).	06
4	**Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS** Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts.	06
5	**Raspberry pi3 interfacing with Sensor** DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.	06
6	**IoT Case Studies:** Introduction to Cloud Storage Models, Communication API.	06

Sr. No.	Reference Books
1	Rao, M. (2018). Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd
2	Baichtal, J. (2013). Arduino for beginners: essential skills every maker needs. Pearson Education.
3	Schwartz, M. (2016). Internet of Things with ESP8266. Packt Publishing Ltd.
4	Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. " O'Reilly Publisher Media, Inc."
Sr. No.	**Important web links**
1	https://www.coursera.org/learn/iot

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards						
Course Code	MDM 3.4						
Course Category	Minor Program Core						
Course title	**Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**			**Total Credits**
	One Month						03
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites (if any)	Prerequisites for this course typically include a solid background in digital electronics, microcontrollers						
Course Rationale	The course provides a comprehensive introduction to the core principles and concepts IoT. It aims to equip students with the foundational knowledge and skills necessary to program and design the IoT systems.						
Course Objectives	The students will learn 1. To expose students to real working environment and get acquainted with the organization structure, business operations and administrative functions 2. To have hands on experience in the related field to get exposure with the industrial trend 3. To promote cooperation and to develop synergetic collaboration between industry and the university 4. To set the step for future recruitment 5. Get familiarity with professional skills 6. Understand the information required for entrepreneurship						
Course Outcomes	The students will be able to 1. Know the industrial working environment 2. Utilize the technical resources 3. Write technical documents and appear for interview / power point presentations/ technical discussions 4. Develop attitude of a team player and ability of life-long learning 5. Adapt and develop professional skills required for employability 6. Motivation for entrepreneurship						

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1							3	
CO 2	3	2	3	3							3	
CO 3	3	2	3	3	3						3	
CO 4	3	1	3	3							3	
CO 5	3	3		1							3	

CO 6	3	2	3	3	3						3	3
PSO1	3	3	3	3	2						1	
PSO2	2	3	1	3	2						2	

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	**Course Content**	**Duration**
1	Four-week industrial training in a reputed industry from stand point view of IoT - electronics engineering is mandatory. Students should learn and understand the concepts of IoT system design, industrial organization and management. They should get familiarity with different departments like R & D, production, quality, purchase, sales & marketing and other. Students should submit detail report in the given format to the department / program in which all details of internship must be included. Panel of faculty members appointed by the program coordinator will assess the individual student.	**4 week**
Sr. No.	**Reference Books**	
1	Articles from reputed journals, magazines, websites, real world problems, case studies, Survey reports	
2	Institute's Laboratory Course Manual and equipment wise Standard Operating Procedure to follow.	
Sr. No.	**Important web links**	
1	As per requirement	

Year, Program, Semester	Multidisciplinary Minor III, 4th Semester onwards						
Course Code	MDM 3.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	-	-	-	-	02		
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of piping design basics.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Exit after SY B. Tech (Computer Science and Technology) Claim for Diploma, Curriculum

Shivaji University, Kolhapur
Department of Technology

B. Tech (Computer Science and Technology), Exit After Second Year (Diploma in Computer Science and Technology)

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	SWAYAM (NPTEL) or any other MOOCs Or any other course from in face to face mode (Program Core Courses)	DC-CST 1	Programming in modern C++ **	02	-	-	02	02	30:70	00:00
2.		DC- CST 2	Computer Networks And Internet Protocol **	02	-	-	02	02	30:70	00:00
3.		DC- CST 3	Computer architecture and hardware maintenance **	02	-	-	02	02	30:70	00:00
4.	Program Based Internship	DC-PBI	Industrial Internship	One Month				04	00:00	50:50
				-	**-**	**-**	**-**	**10***	**300****	**100**
			Total Hours	**06**	**-**	**-**	**06**	**-**	**-**	**-**

Note: The Workload against the Diploma Course will be finalized at the Program Level considering the strength of the students seeking for the Diploma.

*****Obtaining these credits will be in addition to 85 regular credits up to SY B. Tech. Also in such cases, acquiring certificate after First Year is mandatory.

****** There is an option for End Semester Examination either on respective MOOC platform if any or through the University System.

Note: Program Specific Industry Internship to be completed by such students before commencement of TY B. Tech.

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Exit after Second Year of B. Tech (Computer Science and Technology), Diploma Claim</td></tr>
<tr><td>Course Code</td><td colspan="5">DC-CST 1</td></tr>
<tr><td>Course Category</td><td colspan="5">Course for Diploma in Computer Science and Technology</td></tr>
<tr><td>Course title</td><td colspan="5">Programming in modern C++</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>02</td><td>-</td><td>-</td><td>02</td><td>02</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Data Structures, Object Oriented Programming Lab</td></tr>
<tr><td>Course Objectives</td><td colspan="5">Course is aimed to-
1. Teach the basic concepts and techniques which form the object oriented programming paradigm.
2. Strengthen their problem solving ability by applying the characteristics of an object-oriented approach.
3. Introduce object oriented concepts in C++.
4. Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
5. Implement the object oriented concepts to solve problems
6. Develop an application applying the object oriented concepts</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Upon completion of this course, student should be able to –
1. Explain what constitutes an object-oriented approach to programming and identify potential benefits of object-oriented programming over other approaches.
2. Apply an object-oriented approach to developing applications of varying complexities
3. Take a problem and develop the structures to represent objects and the algorithms to perform operations.
4. Apply standards and principles to write truly readable code.
5. Test a program and, if necessary, find mistakes in the program and correct them.
6. Develop applications using object oriented concepts.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1		3													
CO 2	3														
CO 3			2												
CO 4	2														
CO 5				1											
CO6			2												

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Fundamentals of C++:** The Origins of C++, Encapsulation, Polymorphism, Inheritance, Function Overloading, Operator Overloading, Constructors & Destructors, C++ key words.	2
II	**Classes & Objects:** Relation of Classes, Structures & Union, Friend Functions, Friend Classes, Inline Functions, Parameterized constructors, Static class members, Scope resolution operators, Passing objects to functions, nested classes, and local classes.	3
III	**Arrays, Pointers, Dynamic Allocation Operators**: Arrays of objects, Pointers to objects, Type checking C++ Pointers, This Pointer, Pointers to derived types, Pointers to class members, Dynamic allocation operators- new & delete operators.	3
IV	**Function** **Function:** Reference arguments, overloaded functions, inline functions, default arguments, returning by reference, friend functions and static functions. **Virtual Functions**: Accessing Normal and Virtual member functions, late binding, pure virtual functions, Abstract classes, Virtual base classes.	6
V	**Operator Overloading & Inheritance:** Overloading unary and binary operators, Overloading extraction and insertion operators, data Conversion. **Inheritance**: Derived class and base class, derived class constructors, over riding member functions, public and private inheritance, multiple inheritance.	6
VI	**File and Streams:** Streams, String I/O, Character I/O, Object I/O, I/O with multiple objects, File pointers and redirections. **Advanced C++ features:** Templates, Exception handling, Library organisation and containers.	6
Text Books / Reference Books		
i)	Object oriented programming with C++ E. Balguruswami	
ii)	C++: The Complete Reference Fourth Edition - Herbert Schildt (McGraw-Hill) , 4th edition	
iii)	C++ Concurrency in Action, 2nd Edition by Anthony Williams, 2019.	
iv)	C++17 - The Complete Guide by Nicolai M. Josuttis, 2020.	
v)	Functional Programming in C++ by Ivan Čukić, 2018	
vi)	Professional C++, 4th Edition by Marc Gregoire, 2018.	
vii)	Effective Modern C++: 42 Specific Ways to Improve Your Use of C++11 and C++14 by Scott Meyers, 2015.	
Important web links		
i)	https://onlinecourses.nptel.ac.in/noc22_cs43/preview	

Experiment No.	Experiment Titles	Hours
1.	Write a program to demonstrate concept of class. For example: create class matrix, class string, class car, class date, class time, class person etc.	02
2.	Write a program to demonstrate following Function concepts a. Function overloading b. Constructors of all types c. Default parameters, returning by reference d. Demonstration of friend function e. Demonstration of static function	02
3.	Write a program to demonstrate a. Operator overloading –for unary as well as binary operation. b. Apply above concept on matrix and string classes created above.	02
4.	Write a program to demonstrate C^{++} s capability of all types of inheritance a. Single, multiple, multivalued b. Virtual function. c. Abstract class d. Runtime polymorphism	02
5.	Write a program for new and delete operators, pointers to objects.	02
6.	Write a program for pointers to pointers, this pointer.	02
7.	Write a program for Templates, Exception handling.	02
8.	Write a program for Stack and Queue.	02
9.	Write a program for the linked list	02
10.	Write a program for Binary tree, Traversal of a Binary tree.	02

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">Exit after Second Year of B. Tech (Computer Science and Technology), Diploma Claim</td></tr>
<tr><td>Course Code</td><td colspan="6">DC-CST 2</td></tr>
<tr><td>Course Category</td><td colspan="6">Course for Diploma in Computer Science and Technology</td></tr>
<tr><td>Course title</td><td colspan="6">Computer Networks And Internet Protocol</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>02</td><td>-</td><td>-</td><td colspan="2">02</td><td>02</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>-</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Data Communication and Networking</td></tr>
<tr><td>Course Objectives</td><td colspan="6">Course is aimed to -
1. Provide knowledge about basics of computer network
2. Understand the knowledge about the Functions of Physical Layer.
3. Gain the knowledge about different framing techniques and network layer protocols for data communication.
4. Give detail knowledge of Transport Layer and protocols.
5. Get knowledge about protocols from application layer.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course students should be able to-
1. Explain types of switching.
2. Explain types of services
3. Describe congestion control ant TCP protocol
4. Explain different types of protocol
5. Describe error control and flow control
6. Explain concepts of computer networks.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1														
CO 2		2													
CO 3	3														
CO 4			2												
CO 5	1														
CO6				1											

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction** Introduction to Computer Networks – History, Circuit Switching and Packet Switching, TCP/IP Protocol Stack – Basic Overview	04
II	**Application Layer** Application Layer Services (HTTP, FTP, Email, DNS)	04
III	**Transport Layer** Transport Layer Primitives – Connection Establishment and Closure, Flow Control and Congestion Control at the Transport Layer, Transmission Control Protocol – Basic Features, TCP Congestion Control	05
IV	**Network Layer** Network Layer Primitives – IP Addressing, IP Routing – Intra Domain Routing Protocols, Inter Domain Routing Protocols (BGP), IP Services – SNMP, ARP	05
V	**Datalink Layer** Data Link Layer Service Primitives – Forwarding, Flow Control, Error Control, Media Access Control - Channel Access Protocols, Framing	04
VI	**Case Study** End to End Principles of Computer Networks	04
Text Books		
i)	1B. A. Forouzan, “Data Communications and Networking”, 4th Edition, Tata McGraw-Hill, 2013, ISBN-10: 1-25-906475-1	
ii)	Computer Networks – Andrew S. Tanenbaum (Pearson Education) 4th Edition	
iii)	Computer Networking: A Top - Down Approach, by Ames Kurose, Keith Ross	
iv)	TCP/IP Guide, Charles M. Kozierok, Available Online - http://www.tcpipguide.com/	
Reference Books		
i)	William Stallings, “Data and computer Communication”, 7th Edition, Pearson Education, 2003, ISBN-13: 978-0131006812, ISBN-10: 0131006819.	
ii)	Larry L. Peterson and Bruce S. Davie, “Computer Networks a systems approach”, 5th Edition, Morgan Kaufmann an imprint of Elsevier, 2014, ISBN: 978-93-80501-93-2	
Important web links		
i)	https://onlinecourses.nptel.ac.in/noc22_cs19/preview	

Year, Program, Semester	Exit after Second Year of B. Tech (Computer Science and Technology), Diploma Claim					
Course Code	DC-CST 3					
Course Category	Course for Diploma in Computer Science and Technology					
Course title	**Computer architecture and hardware maintenance**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	02	-	-	02		02
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	-	-	100
Pre-requisites(if any)	Basic knowledge of digital and computer hardware basis					
Course Objectives	The Course is aimed to - 1. Introduce principles of computer organization and the basic architectural concepts. 2. Understand basic organization, design, and programming of a simple digital computer and introduces simple register transfer language to specify various computer operations. 3. Get the knowledge of computer arithmetic, instruction set design, micro programmed control unit, pipelining and vector processing, memory organization and I/O systems, and multiprocessors					
Course Outcomes	Upon completion of this course student should be able to - 1. Learn about Design of basic computer 2. Know registers, various types of registers and interfacing various registers. 3. Understand how to design architecture of common bus system. 4. Learn about the different micro-operations used, Instruction Cycle, Interrupt Cycle 5. Understand I/O interface, DMA controller, modes of data transfer and various address modes. 6. Understand how to assemble a PC.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2														
CO 2	2														
CO 3			1		1										
CO 4	2	1													
CO 5			2		1										
CO6	1		3												

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Hardware Organisation of computer system:** CPU organization: general register organization, stack organization, instruction formats (three address, two address, one address, zero address and RISC instruction). Addressing modes: Immediate, register, direct, in direct, relative, indexed. CPU Design: Microprogrammed Vs hard wired control. Reduced instruction set computers: CISC characteristics, RISC characteristics, and their comparison.	4
II	**Memory organization** Memory Hierarchy RAM and ROM chips, Memory address map, Memory connections to CPU. Auxiliary memory: Magnetic disks and magnetic tapes, Associative memory, Cache memory, Virtual memory, Memory management hardware, Read and Write operation	4
III	**Arithmetic Operations** Introduction, Addition, Subtraction, Multiplication and Division algorithm.	5
IV	**I/O Organization** Basis Input output system(BIOS) Function of BIOS, Testing and initialization, Configuring the system, Modes of Data Transfer Programmed I/O : Synchronous, asynchronous and interrupt initiated., DMA data transfer	5
V	**8085 Microprocessor:** Introduction, Architecture, Pin diagram, Comparison with 8086.	4
VI	**Architecture of multi-processor systems** Forms of parallel processing, Parallel processing and pipelines, basic characteristics of multiprocessor, General purpose multiprocessors, Interconnection networks: time shared common bus, multi-port memory, cross bar switch, multi stage switching networks and hyper cube structures.	4
	Experiment Titles	
i)	Demonstration of following: 1. motherboard 2. Key board & Keyboard decoder 3. Video Adapter & display controllers 4. Floppy Drive, CD Drive and Hard Disk. 5. Multifunction Input/Output controllers 6. Assembly of PC	
ii)	Troubleshooting & repair of following equipment: 1. Dot Matrix Printer, Laser, Inkjet Printer. 2. Digital Plotter 3. C. P. U. 4. Disk Drive	
iii)	Trouble Shooting of 1. Network 2. Power Supplies.	

Text Books/ Reference Books	
i)	Computer Architecture and Organisation by Moris Mano, 3rd Edition, Pearson
ii)	Computer Architecture and Organization by J.P.Hayes, 3rd Edition, Tata McGrawHills
iii)	Structured Computer Organisation by Tanenbaum Andrew S, PHI
iv)	E-books/e-tools/relevant software to be used as recommended by AICTE/NITTTR, Chandigarh.
Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Exit after Second Year of B. Tech (Computer Science and Technology), Diploma Claim				
Course Code	DC-PBI				
Course Category	Course for Diploma in Computer Science and Technology				
Course title	**Industrial Internship**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	One Month Industrial Training				04
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**EOE**	**Total**
	-	-	50	50	100
Pre-requisites(if any)	Basic knowledge of Computer Systems				
Course Objectives	The course is aimed to – 1. Provide exposure to corporate culture. 2. Provide exposure to latest technologies used in the industry. 3. Learn to communicate efficiently. 4. Apply fundamental principles of Computer Science in real-world problems.				
Course Outcomes	Upon completion of this course students will be able to – 1. Apply fundamental principles of Computer Science. 2. Become specialized in a particular technology domain. 3. Become updated with all the latest changes in technological world. 4. Communicate efficiently. 5. Identify, formulate and model problems and find engineering solution based on a				

	systems approach. 6. Get awareness of the social, cultural, global and environmental responsibility as an engineer.

Curriculum Content
Course Contents As per the approved academic structure, students will be allowed to take internships. Below are the guidelines/rules and regulations for the students to do for the internship – Students have to complete one month of industrial training program in Software /hardware Industries, Telecom Sectors, and Corporate Offices with the approval of the Department. The student will maintain a log of work done on daily basis and important ideas or practices that he / she has learnt during the internship. The log-book may also be dually signed by the student and the mentor from the industry. The teacher will periodically assess the performance of individual student. **Course Assessment** The student has to submit a interim report and final detailed report based on the internship immediately after the completion of the internship. The students can register the 'Online Internship'/MOOC courses/online platform course by taking the prior permission from the Department. The IE and EE of the same will be jointly conducted by appointed examiners. Note: Use of Open source tools should be preferred.

Shivaji University
Vidya Nagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Second Year B. Tech (Computer Science and Technology) Honor and Honor with Research Detailed Curriculum

2024-25 onwards

Shivaji University, Kolhapur

Department of Technology

B. Tech (Computer Science and Technology), Honors

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	SWAYAM (NPTEL) or any other MOOCs (Program Core Courses) Or Self-study mode with University's Semester End Examination	HN- 1	Research Methodology	03	-	-	03	03	30:70	00:00
2.		HN- 2	Computer Vision and Image Processing	03	-	-	03	03	30:70	00:00
3.		HN- 3	Geographical Information System	03	-	-	03	03	30:70	00:00
4.		HN- 4	Artificial Neural Network and Natural Language Processing	03	-	-	03	03	30:70	00:00
5.		HN- 5	Real Time Systems	03	-	-	03	03	30:70	00:00
6.	Ability Enhancement Course	HN-AEC1	Advanced Laboratory Practice	-	-	04	04	02	-	50:50
				-	-	-	-	**17**	**500**	**100**
			Total Hours	15	00	04	**19**	-	-	-

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Computer Science and Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HN-1</td></tr>
<tr><td>Course Category</td><td colspan="5">Core</td></tr>
<tr><td>Course title</td><td colspan="5">Research Methodology</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>03</td><td>-</td><td>-</td><td>03</td><td>03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">30</td><td>70</td><td>00</td><td>00</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basics about project implementation and paper presentation</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Course is aimed to- -
1. Familiarize students with various research methodologies and approaches used in scientific inquiry.
2. Develop students critical thinking and analytical skills necessary for conducting research.
3. Provide students with practical guidance on designing research studies, including formulating research questions and hypotheses.
4. Equip students with the necessary skills to conduct literature reviews, analyze data, and interpret research findings.
5. Cultivate ethical research practices and promote integrity in the research process.
6. Prepare students for effectively communicating research findings through presentations, reports, and scholarly publications.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Upon completion of this course, student should be able to –
1. Demonstrate an understanding of different research methodologies, including quantitative, qualitative, and mixed methods approaches.
2. Evaluate existing research literature, identify gaps, and formulate relevant research questions and hypotheses.
3. Develop proficiency in research design, including selecting appropriate methodologies, sampling techniques, and data collection methods.
4. Gain practical experience in data analysis techniques, such as statistical analysis, qualitative coding, and thematic analysis.
5. Adhere to ethical guidelines and principles in research conduct, including obtaining informed consent, ensuring confidentiality, and avoiding plagiarism.
6. Communicate research findings through written reports, oral presentations, and academic publications.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	3	2	-	1	-	3	-	3	-	-	3	-	3
CO 2	-	3	-	3	-	-	-	-	-	3	-	2	-	3	-
CO 3	-	3	3	2	-	-	2	-	1	-	3	-	-	3	3
CO 4	-	2	-	3	3	-	-	1	-	-	3	-	-	2	-
CO 5	-	-	-	-	3	-	-	3	-	-	-	-	-	-	-
CO6	-	-	-	-	-	3	-	-	3	3	-	3	-	-	-

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction to Research Methodology** Understanding the Research Process, Importance of Research in Engineering, Types of Research: Basic vs. Applied, Quantitative vs. Qualitative, Research Paradigms: Positivism, Interpretivism, Pragmatism, Formulating Research Questions and Objectives, Literature Review: Search Strategies, Critical Analysis, Research Ethics and Integrity, Research Design: Experimental, Descriptive, Exploratory, Case Study.	8
II	**Research Design and Sampling Techniques** Research Variables and Hypothesis Formulation, Experimental Design: Control Groups, Randomization, Replication, Survey Design: Questionnaire Construction, Scaling Techniques, Sampling Methods: Probability Sampling, Non-probability Sampling, Sample Size Determination and Power Analysis, Case Study Research Design, Qualitative Research Design: Interviews, Focus Groups, Observations, Mixed-Methods Research Design.	7
III	**Data Collection and Analysis** Surveys, Interviews, Observations, Experiments, Instrumentation and Measurement Tools, Data Quality and Validation, Data Analysis Methods: Descriptive Statistics, Inferential Statistics, Statistical Software Tools: SPSS, R, MATLAB, Qualitative Data Analysis: Coding, Theme Analysis, Narrative Analysis.	6
IV	**Research Proposal Development** Components of a Research Proposal: Title, Abstract, Introduction, Literature Review, Methodology, Timeline, Budget, Writing and Organizing a Research Proposal, Proposal Review Process and Feedback Incorporation, Presentation Skills for Research Proposals, Grant Writing Techniques and Funding Opportunities, Ethical Considerations in Research Proposal Development.	7
V	**Advanced Research Methods** Longitudinal and Cross-Sectional Studies, Meta-Analysis and Systematic Reviews, Action Research and Participatory Research, Simulation and Modeling Techniques, Big Data Analytics in Engineering Research, Emerging Trends in Research Methodology.	6
VI	**Research Proposal Development** Project Planning and Time Management, Collaboration and Teamwork in Research Projects, Data Management and Documentation, Intellectual Property Rights and Patents, Writing and Publishing Research Papers, Peer Review Process and Journal Selection.	6

Text Books	
i	*Creswell, J. W., & Creswell, J. D., 2017, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications, 978-1506386763.*
ii	*Bryman, A., & Bell, E., 2015, Business Research Methods, Oxford University Press, 978*
iii	*Kumar, R., 2019, Research Methodology: A Step*
Reference Books	
i	*Neuman, W. L., 2013, Social Research Methods: Qualitative and Quantitative Approaches. Pearson, 978*
ii	*Kothari, C. R. Garg, G., Research Methodology: Methods and Techniques, 5th Edition, New Age Int. Publisher, 978*
Useful links	
i	https://www.researchgate.net/topic/Research-Methodology
ii	https://www.coursera.org/learn/research-methods
iii	https://www.socialresearchmethods.net/kb
iv.	https://onlinecourses.nptel.ac.in/noc23_ge36/preview
Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	B. Tech Computer Science and Technology (Honors/Honors with Research)					
Course Code	HN-2					
Course Category	Core					
Course title	**Computer Vision and Image Processing**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics					

Course Objectives	The Course is aimed to– 1. Learn about digital image representation, transforms, and enhancement techniques. 2. Explore color image processing methods and models. 3. Understand image restoration techniques and compression models, including standards and methods. 4. Gain knowledge of spatial feature extraction, segmentation, and classification techniques for image analysis. 5. Recognize challenges and techniques in 3D shape sensing, including stereo vision and direct sensing methods. 6. Explore applications of image processing in recognition tasks and image databases.
Course Outcomes	Upon completion of this course, student should be able to – 1. Apply digital image processing techniques to analyze and manipulate images effectively. 2. Implement image enhancement and restoration algorithms to improve image quality. 3. Understand the principles behind image compression and apply appropriate methods to reduce data size while maintaining quality. 4. Analyze and extract features from images for tasks such as segmentation and classification. 5. Demonstrate understanding of 3D shape sensing techniques and their applications. 6. Identify and apply emerging IT applications of image processing in real-world scenarios.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	2	-											
CO 2	2	3	-	1	1								2		
CO 3	3	1	2	2	1								1		
CO 4	1	1	3	2	1								1		
CO 5	1	2	2	1	2								2		
CO6	2	2	3	2	3	1							1		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Digital Image Fundamentals**: - Digital image Representation – Functional Units of an Image processing system. Visual perception – Image Model _ Image sampling and Quantization – grayscale resolution – pixel relationship – image geometry. Image Transforms – Unitary Transform, Discrete Fourier Transform, Cosine Transform, Sine Transform, Hadamard Transform, Slant and KL Transform	7

II	**Image Enhancement** – Histogram processing – Spatial operations – Image smoothing- Image Sharpening – Color Image Processing methods- Color Image Models	6
III	**Image restoration and compression Degradation Model** – Discrete Formulation – Circulant matrices – Constrained and Unconstrained restoration geometric transformations fundamentals – Compression Models – Error Free Compression – Lossy Compression – International Image Compression Standards.	7
IV	**Image Analysis and Computer Vision**: Spatial feature Extraction – Transform feature –Edge detection-Boundary Representation-Region Representation-Moment Representation-Structure-Shape Features-Texture-Scene Matching and Detection-Image Segmentation-Classification techniques-Morphology-Interpolation	7
V	**Sensing 3D shape**: how the 3rd dimension changes the problem. Stereo 3D description, 3Dmodel, matching, TINA. Direct 3D sensing-structured light, range finders, range image segmentation	6
VI	**Emerging IT applications**: Recognition of characters, Fingerprints and faces-Image databases	6
Text Books		
i	Fundamentals of Digital Image Processing-A.K.Jain	
ii	Image Processing and machine vision-Milan Sonka,Vaclav Hlavae	
Reference Books		
i	Pattern Recognition Principles-J.T. Tou and R.C.Gonzalez	
ii	Syntactic Pattern Recognition and applications.-King Sun Fun	
iii	Computer vision-Fairhurst (PHI).	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Year, Program, Semester	B. Tech Computer Science and Technology (Honors/Honors with Research)				
Course Code	HN-3				
Course Category-	Core				
Course title	**Geographical Information System**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-		03	03

Evaluation Scheme	**ISE**	**ESE**	**IE**	EE	**Total**
	30	70	00	00	100
Pre-requisites(if any)	Basic knowledge of Computer Programming, Databases, mathematics etc.				
Course Objectives	The Course is aimed to- 1. Help student to understand the Geographical Information Systems 2. Provide knowledge about handling editing and analysis of Spatial Data. 3. Explain procedures for Analytical Modeling in GIS 4. Give overview of Development of Computer Methods for handling Spatial Data 5. Describe the Data Quality issues , Human and Organizational issues in GIS 6. Introduce the trends in project design and Future of GIS .				
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain the components of Geographical Information Systems. 2. Explain the editing and analysis of Spatial Data 3. Demonstrate the editing and analysis of Spatial Data 4. Formulate Computer Methods for handling Spatial Data 5. Describe the Data Quality issues , Human and Organizational issues in GIS 6. Design and develop Geographical Information system				

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3					2									
CO 2			3		2										
CO 3			3		3										
CO 4	3				3						2				
CO 5	3			2							2				1
CO6	3		2		3										

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	**Course Content**	**Hours**
I	**Introduction to GIS** GIS Introduction, Spatial Data, Spatial Data Modeling, Attribute Data Management.	06
II	**Data Inputting** Data , Input , Editing , Data Analysis	06
III	**Modeling in GIS** Analytical Modeling in GIS , Output : From new Maps to Enhanced Decision	07
IV	**Development of Computer Methods** Development of Computer Methods for handling Spatial Data	06
V	**Data Issues** Data Quality issues , Human and Organizational issues	07

VI	**Project Design** GIS project design and Management , Future of GIS	07
	Text Books	
i)	"An Introduction To Geographical Information Systems " Ian Heywood , Sarah Cornelius Steve Carver Third Edition	
	Reference Books	
i)	Principles of Geographic Information Systems- An Introductory Text Book , Editors: Otto Huisman and Rolf A. The International Institute of Geo information Science and Earth Observatio , Fourth ,2009	
ii)	Introduction to Geographic Information Systems , Chang Kang-tsung (Karl), McGrawHill , Any above third edition	
	Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Year, Program, Semester	B. Tech Computer Science and Technology (Honors/Honors with Research)					
Course Code	HN-4					
Course Category	Core					
Course title	**Artificial Intelligence and Natural Language Processing**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Mathematical concepts such as statistics, calculus, probability, and linear algebra.					
Course Objectives	The Course is aimed to- - 1. Understand the fundamentals of artificial intelligence, its problem-solving nature, and the various techniques used in AI applications. 2. Explore the concept of problem spaces, the AI problem, and the underlying assumptions that guide the design of search programs. 3. Study and apply heuristic search techniques such as generate-and-test, hill climbing etc. 4. Search into knowledge representation issues, focusing on predicate logic, representation, and mappings, along with various approaches and challenges in knowledge representation.					

	5. Understand the difference between procedural and declarative knowledge, explore logic programming. 6. Explore the goals of NLP, survey applications, and understand different levels of linguistic processing.
Course Outcomes	Upon completion of this course, student should be able to – 1. Grasp the foundational principles of artificial intelligence, its problem-solving nature, and the role of AI techniques. 2. Apply various heuristic search techniques to solve complex problems, including generate-and-test, hill climbing, and best-first search. 3. Develop proficiency in representing knowledge using logic, including predicate logic, computable functions, and resolution techniques. 4. Acquire skills in designing and implementing rule-based systems, and applying statistical reasoning in AI applications. 5. Gain practical knowledge of natural language processing, including computational morphology etc.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2		3		3										
CO 2	2	3													
CO 3	2	2	3												
CO 4	3		3												
CO 5		2	3												

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction, Problems, Problem Spaces, and Search** The AI problem, the underlying assumption, what is an AI technique? , the level of the model, criteria for success, some general reference, defining the problem as a state space search, production systems, problem characteristics, production system characteristics, issues in the design of search programs, additional problems	6
II	**Heuristic Search Techniques** Generate-and-test, Hill climbing, Best-first search, Problem reduction, constraint satisfaction, means-end analysis	6
III	**Knowledge Representation Issues, Predicate Logic** Representation and mappings, approaches to knowledge representation, issues in knowledge representation, the frame problem, representing simple facts in logic, representing instance and ISA relationships, computable functions and predicates, resolution, natural deduction	7
IV	**Representing Knowledge Using Rules, Statistical Reasoning** Procedural versus declarative knowledge, logic programming, forward versus backward reasoning, matching, control knowledge, probability and bayes theorem, certainty factors and rule-based systems, Bayesian networks, dempster-shafer theory, fuzzy logic	7

V	**Goals of NLP, Resources for NLP** Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, lexicons and knowledge bases	6
VI	**Computational morphology** lemmatization, Part-of-Speech Tagging, Finite-State Analysis. **Ambiguity and its resolution:** Syntactic ambiguities and heuristics, lexical ambiguities and selectional restrictions, indeterminacy of reference	7
Text Books		
i	Elaine Rich, Kevin Knight, Shivashankar B Nair, " Artificial Intelligence" third edition, McGraw Hill	
ii	Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) *Readings in natural language processing*. Los Altos, CA, 1986: Morgan Kaufmann.	
Reference Books		
i	Jurafsky, D. & J. Martin. 2000. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition* Prentice Hall.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Year, Program, Semester	B. Tech Computer Science and Technology (Honors/Honors with Research)				
Course Code	HN-5				
Course Category	Core				
Course title	**Real Time Systems**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	03	-	-	03	03
Evaluation Scheme	**ISE**	**ESE**	**IE**	EE	**Total**
	30	70	00	00	100
Pre-requisites(if any)	Operating System, Advanced Operating System				
Course Objectives	The Course is aimed to- - 1. Discuss basic concepts of real-time systems. 2. Explain characteristics of a real-time system in context with real-time kernels,				

	inter-task communication and synchronization. 3. Discuss real-time memory management, system performance and optimization 4. Provide the basics of real-time queuing models, reliability, testing and fault tolerance 5. Discuss the basics of RTS in the interpretation of multi-processing systems, hardware/ software integration 6. Provide real-time operating system concepts and applications.
Course Outcomes	Upon completion of this course, student should be able to – 1. Describe basic concepts of real-time systems. 2. Recognize the characteristics of a real-time system in context with real-time kernels, inter-task communication and synchronization. 3. Study and analyse real-time memory management, system performance and optimization 4. Interpret the basics of real-time queuing models, reliability, testing and fault tolerance 5. Apply the basics of RTS in the interpretation of multi-processing systems, hardware/ software integration 6. Describe real-time operating system concepts and applications.

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-											
CO 2	3	1		2	2								2		
CO 3	2	3	1	2	2								2		
CO 4	3	2	1	2	2								2		
CO 5	3	2	1	2	2								2		
CO6	1	2	2	3	3								2		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Basic Real-Time Concepts** Terminology, Real-Time design Issues, Example Real-Time Systems, brief history, Language features, Commonly used programming languages, Phases of the software life cycle, Non temporal Transitions in the Software life cycle, Spiral Model, Natural languages, Mathematical specification, flowcharts, structure charts, Pseudocode and Programming Design languages, Finite state Automata, Data flow diagrams, Petri nets, Warnier-Orr Notation, State charts, Sanity in using graphical Techniques	8
II	**Real Time Kernels:** Polled Loop Systems, Phase/ State-Driven Code, Coroutines, Interrupt-Driven Systems, Foreground/ Background Systems, Full-Featured Real-Time Operating systems, POSIX. **Inter-Task Communication and Synchronization:** Buffering Data, Mailboxes, Critical Regions, Semaphores, Event flags and signals, Deadlock	6
III	**Real-Time Memory Management:** Process Stack Management, Dynamic Allocation, Static Schemes. **System Performance Analysis and Optimization:** Response-Time Calculation, Interrupt latency, Time-Loading and its Measurement, Scheduling is NP-Complete, Reducing	6

	Response times and Time-loading, Analysis of Memory requirements, Reducing Memory-Loading, I/O Performance	
IV	**Queuing Models:** Probability functions, Discrete, Basic Buffer size calculation, Classical Queueing theory, Little's Law, Erlang's Formula. **Reliability, Testing and Fault Tolerance:** Faults, Failures, Bugs and Effects, Reliability, Testing, Fault Tolerance	6
V	**Multi-Processing Systems:** Classification of Architectures, Distributed Systems, Non-Von Neuman Architectures. **Hardware/ Software Integration:** Goals of Real-Time system integration, Tools, Methodology, The software Heisenberg Uncertainity Principle	6
VI	**Real-Time Applications** Real-Time systems as complex systems, First Real-time application, Real time Databases, Teal-Time Image Processing, Real-Time Unix, Building Real-time Applications with Real-time programming languages	7
Text Books		
i	*"Real-Time Systems Design and Analysis, An Engineer's Handbook",* Phillip .A. Laplante, PHI, 2nd Edition.	
ii	*"Real-Time Systems Design",* Levi Shem, Tov and Ashok K. Agrawala, New York, McGraw Hill.	
Reference Books		
i	*"Proceedings of IEEE Special Issue on Real-Time Systems Design",* Jan. 1994.	
ii	*"Real-Time Systems Design and their Programming Languages",* Burns, Alan and Andy Wellings, New York, Addison-Wesley.	
iii	*"The Design of Real-Time Applications",* M. Blackman, New York, John Wiley & Sons.	
iv	*"Real-Time Systems",* C. M. Krishna, K. G. Shin, TMGH.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">B. Tech Computer Science and Technology (Honors/Honors with Research)</td></tr>
<tr><td>Course Code</td><td colspan="5">HNR-AEC1</td></tr>
<tr><td>Course Category</td><td colspan="5">Ability Enhancement Course</td></tr>
<tr><td>Course title</td><td colspan="5">Advanced Laboratory Practice</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>04</td><td>04</td><td>02</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IPE</td><td>EOE</td><td>Total</td></tr>
<tr><td colspan="2">-</td><td>-</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="5">Basics of Computer Vision and Image Processing ,Artificial Neural Network and Geographical Information System</td></tr>
<tr><td>Course Objectives</td><td colspan="5">The Lab is aimed to-
1. Understand multilayer feed forward networks, RNN and single-layer feedback networks and associative memories
2. Learn various techniques of image enhancement, compression , segmentation etc.
3. Provide students with the principles of how to manage and use GIS and Remote Sensing to work with real world issues.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">Upon completion of this course, student should be able to –
1. Perform point operations and filtering in spatial domain.
2. Segment image into regions.
3. Understand approaches to syntax and semantics in NLP.
4. Analyse grammar formalism and context free grammars
5. Create mosaic of images / toposheets / aerial photographs and preparation of thematic maps by process of digitization.
6. Identify, understand and analyze the principles of Neural Networks</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO 2	PSO3
CO1	2														
CO2		2											1		
CO3	1	2					2						1		
CO4	-		2	2									2		
CO5			2			2									
CO6	2						2	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Experiment No.	Experiment Title/Objective	Hours
1.	Conversion of 24 bit color image to 8 bit , 4 bit, 1 bit image	02
2.	Image negation, power Law correction	02
3.	Histogram mapping & equalization, stretching	02
4.	Image smoothing , sharpening	02
5.	Edge detection – use of Sobel, Prewitt and Roberts operators	02
6.	Familiarization with GIS Software, Data Input	02
7.	Geo Referencing and Projections	02
8.	Digitization of Map/ Toposheet	02
9.	Creation of Thematic Maps	02
10.	Base Map Preparation	02
11.	Word Analysis and Word Generation	02
12.	Morphology and N-Grams, N-Grams Smoothing	02
13.	POS Tagging: Hidden Markov Model	02
14.	Implementation of Mc-Culloch Pitts Model	02
15.	Hopfield model: Associative memory problem	02
16.	Optimization problems	02
17.	Simple Perceptions, feed forward n/w	02
18.	Multi-layer Network, RNN	02
General Instructions: Students have to perform 12-15 practical's from the list		
Reference Books		
i)	Concept and Techniques of GIS by C.P.L.O. Albert, K.W. Yong, Printice Hall Publishers	
ii)	Image Processing, Analysis & Machine Vision, Milan Sonka, Thomson Publication .	

iii)	James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
iv)	Introduction to the theory of neural Computation-Hertz Keogh, Palmer
v)	GIS SOFTWARE Arc GIS / ERDAS / Mapinfo / ILWIS

Shivaji University, Kolhapur

Department of Technology

B. Tech (Computer Science and Technology), Honors with Research

Teaching & Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	SWAYAM (NPTEL) or any other MOOCs (Program Core Courses) Or Self-study mode with University's Semester End Examination	HNR- 1	Research Methodology	03	-	-	03	03	30:70	00:00
2.		HNR – 2	Computer Vision and Image Processing	03	-	-	03	03	30:70	00:00
3.		HNR – 3	Geographical Information System	03	-	-	03	03	30:70	00:00
4.		HNR – 4	Artificial Neural Network and Natural Language Processing	03	-	-	03	03	30:70	00:00
5.		HNR – 5	Real Time Systems	03	-	-	03	03	30:70	00:00
6.	Ability Enhancement Course	HNR-AEC1	Advanced Laboratory Practice	-	-	04	04	02	-	50:50
7.	Project Based Learning	HNR –PBL	*Additional Research Project	-	-	06	06	03	00:00	50:50
				-	**-**	**-**	**-**	**20**	**500**	**200**
			Total Hours	**15**	**-**	**10**	**25**	**-**	**-**	**-**

Note: For Honors with Research, the courses and the credits as that for Honors will be the same. In addition, there will be 3 credits against an additional research project completion with success in publishing at least one research paper in a peer reviewed journal.

Year, Program, Semester	B. Tech Computer Science and Technology (Honors with Research)						
Course Code	HNR-PBL						
Course Category	Project Based Learning						
Course title	**Additional Research Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	06	06		03	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	-	-	-	50	50	-	100
Pre-requisites(if any)	All the courses underlying MDM Featured B.Tech (Computer Science and Technology) Major.						
Course Rationale	The Additional Research Projects course allows B.Tech Computer Science and Technology Major students to pursue advanced research, enhancing their skills and contributing to the field. This course aims to foster critical thinking, problem-solving skills, and research acumen among students while allowing them to explore topics of personal interest and relevance to the discipline. Completion of this course and the attainment of the B. Tech Honors with research Degree make students eligible for Ph.D. studies, facilitating their academic and research progression in Computer Science and Technology engineering or related fields.						
Course Objectives	The Course Teacher will 1. To facilitate exploration of focused research areas in Computer Science and Technology.						
Course Outcomes	Upon completion of this course, student should be able to 1. Formulate research questions and design methodologies. 2. Analyze and interpret data effectively. 3. Synthesize literature to contextualize research. 4. Present findings effectively through oral and written communication. 5. Demonstrate critical thinking and problem-solving in research.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	3	-	-	-	-	2	-	-	2
CO 2	3	-	-	3	2	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	2	-	-	-	-	-	2
CO 4	-	-	-	-	-	-	-	-	-	3	2	-
CO 5	-	3	2	-	-	-	-	2	2	-	-	-

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content
I	**Topic Selection and Proposal Development:** • Identifying research gaps and formulating research questions. • Writing a research proposal outlining objectives, methodology, and expected outcomes. • Conducting rigorous ‘ research topic relevant literature survey’
II	**Research Methodologies:** • Introduction to research design and planning. • Data collection techniques and tools. • Statistical analysis methods.
III	**Conducting Research:** • Implementing the proposed methodology. • Data collection, analysis, and interpretation. • Troubleshooting research challenges.
IV	**Presentation and Communication:** • Preparing and delivering oral presentations. • Writing research reports following standard scientific formats. • Communicating research findings effectively to diverse audiences.

Course Assessment Method
Assessment in this course will be based on the following criteria: 1. Research Proposal (20%): Evaluation of the clarity, feasibility, and originality of the research proposal. 2. Research Progress (30%): Assessment of the student's progress in conducting the research project, including data collection, analysis, and interpretation. 3. Final Research Report (30%): Evaluation of the quality of the written research report, including organization, clarity, depth of analysis, and adherence to scientific standards. 4. Oral Presentation (20%): Assessment of the student's ability to effectively communicate research findings through a formal presentation. Additionally, continuous engagement, participation in research discussions, and adherence to deadlines will be considered in the overall assessment of the course.

Shivaji University Vidyanagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

Pool of Specialization Minors for MDM Featured B. Tech (Computer Science and Technology), Detailed Curriculum

Specialization Minor
In
Artificial Intelligence and Machine Learning
For
B.Tech (Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Specialization Minor in Artificial Intelligence and Machine Learning

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM 1.1	Introduction to AI & Machine Learning	03	-	-	03	03	30:70	00:00
2.		SPM 1.2	Introduction to Data Analytics	03	-	-	03	03	30:70	00:00
3.		SPM1.3	Deep Learning and Neural Network	03	-	-	03	03	30:70	00:00
4.	Minor Program Based Internship	SPM1.4	AI ML Related Internship	One Month				03	00:00	50:50
5.	Project Based Learning	SPM 1.5	Mini Project	-	-	-	-	02	-	50:50
				-	**-**	**-**	**-**	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	**-**	**-**	**-**

Note: If opted the Specialization Minor Program, Internship may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor I: Artificial Intelligence and Machine Learning

Year, Program, Semester	Specialization Minor II, 4th Semester onwards					
Course Code	SPM-1.1					
Course Category	Specialization Minor Program Core					
Course title	**Introduction to AI & Machine Learning**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Mathematical concepts such as statistics, calculus, probability, and linear algebra.					
Course Objectives	The Course is aimed to- 1. To review and strengthen important mathematical concepts required for AI &ML. 2. Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Design and implement machine learning solutions to classification, regression and clustering problems. 2. Evaluate and interpret the results of the different ML techniques. 3. Design and implement various machine learning algorithms in a range of Real-world applications.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2			3										
CO 2	2		2		3										
CO 3			2		2										

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.	9

II	Idea of Machines learning from data, Classification of problem –Regression and Classification, Supervised and Unsupervised learning.	8
III	Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.	8
IV	Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.	8
V	Discussion on clustering algorithms and use-cases cantered around clustering and classification.	6
Text / Reference Books		
i)	Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011	
ii)	Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher.	
iii)	Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017.	
iv)	Tom Mitchell, Machine Learning, McGraw Hill, 2017.	
v)	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.	
vi)	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.	
Lab Work		
i)	Implementation of logical rules in Python	
ii)	Using any data apply the concept of: a. Liner regression b. Gradient decent c. Logistic regression	
iii)	To add the missing value in any data set.	
iv)	Perform and plot under fitting and overfitting in a data set.	
v)	Implementation of clustering and classification algorithms.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work.	

	b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Specialization Minor II, 4th Semester onwards					
Course Code	SPM-1.2					
Course Category	Specialization Minor Program Core					
Course title	**Introduction to Data Analytics**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Solid foundation in basic mathematics, including algebra, calculus, and probability.					
Course Objectives	The Course is aimed to- 1. Provide the knowledge and expertise to become a proficient data scientist 2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science 3. Produce Python code to statistically analyses a dataset 4. Critically evaluate data visualizations based on their design and use for Communicating stories from data.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain how data is collected, managed and stored for data science. 2. Understand the key concepts in data science, including their real- world Applications and the toolkit used by data scientists. 3. Implement data collection and management scripts using MongoDB.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1				3											
CO 2					3										
CO 3			2	2											

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to Data Science, Different Sectors using Data science, Purpose andComponents of Python in Data Science.	7
II	Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.	7
III	Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.	9
IV	Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.	9
V	Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy,security, ethics- A look back at Data Science- Next-generation data scientists.	7
Text / Reference Books		
i)	Joel Grus, Data Science from Scratch, Shroff Publisher Publisher /O'Reilly PublisherMedia	
ii)	Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff PublisherPublisher	
iii)	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from TheFrontline. O'Reilly Publisher Media.	
iv)	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets.v2.1, Cambridge University Press.	
v)	Jake VanderPlas, Python Data Science Handbook, Shroff Publisher Publisher /O'Reilly Publisher Media	
vi)	Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher Publisher /O'Reilly Publisher Media.	
Lab Work		
i)	Python Environment setup and Essentials.	
ii)	Mathematical computing with Python (NumPy).	
iii)	Scientific Computing with Python (SciPy).	
iv)	Data Manipulation with Pandas.	
v)	Prediction using Scikit-Learn	
vi)	Data Visualization in python using matplotlib	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the	

	course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Specialization Minor II, 4th Semester onwards					
Course Code	SPM-1.3					
Course Category	Specialization Minor Program Core					
Course title	**Deep Learning and Neural Network**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics, matrix arithmetic, probability.					
Course Objectives	The Course is aimed to- 1. Strengthen important Mathematical concepts required for Deep learning and neural network. 2. Get a detailed insight of advanced algorithms of neural networks. 3. Introduce different deep learning network.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Design and implement Artificial Neural networks. 2. Decide when to use which type of NN. 3. Implement and analyze various deep learning architectures					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1			2		2										
CO 2		2			2										
CO3		2	3		3										

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Information flow in a neural network, understanding basic structure and ANN.	8
II	Training a Neural network, how to determine hidden layers, recurrent neural network.	8
III	Convolutional neural networks, image classification and CNN.	8
IV	RNN and LSTMs. Applications of RNN in real world.	8
V	Creating and deploying networks using tensor flow and keras	7
Text / Reference Books		
i)	John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.	
ii)	Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, ShroffPublisher /O'Reilly Publisher Media.	
iii)	Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford.	
iv)	Russell Reed, Robert J MarksII, Neural Smithing: Supervised Learning in Feedforward Artificial Neural Networks, Bradford Book Publishers	
Lab Work		
i)	Introduction to Kaggle and how it can be used to enhance visibility.	
ii)	Build general features to build a model for text analytics.	
iii)	Build and deploy your own deep neural network on a website using tensor flow.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work**. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Year, Program, Semester	Specialization Minor I, 4th Semester onwards						
Course Code	SPM 1.4						
Course Category	Specialization Minor Based Internship						
Course Title	**AI ML Related Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	One Month					03	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	The course caters specifically to B.Tech Computer Science and Technology students as the part of multidisciplinary Minor with respect to AI & ML. This course offers practical exposure to industry settings aligned with their chosen discipline, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in additional sector of industry.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment; 2. Promote hands-on experience to the students' in their related field; 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society; 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	3	-	-	-
CO 5	-	-	-	-	-	2	-	-	-	-	-	3
CO 6	-	-	-	-	-	-	-	-	-	-	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The course consists of a one-month internship with respect to applications of AI & ML. Students will be placed in companies or organizations that align with the particular requirement. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
    - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
    - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
    - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
    - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards						
Course Code	SPM 1.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of Computers and programming						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for AI ML applications.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:
Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Specialization Minor
In
Cyber Security
For
B.Tech(Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Specialization Minor in Cyber Security

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM 2.1	Information Theory for Cyber Security	03	-	-	03	03	30:70	00:00
2.		SPM 2.2	Data Encryption	03	-	-	03	03	30:70	00:00
3.		SPM 2.3	Security Assessment and Risk Analysis	03	-	-	03	03	30:70	00:00
4.	Minor Program Based Internship	SPM 2.4	Cyber Security Related Internship	One Month				03	00:00	50:50
5.	Project Based Learning	SPM 2.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	14	300	200
			Total Hours	09	00	00	09	-	-	-

Note: If opted the Specialization Minor Program, Internship may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor II: Cyber Security

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 2.1					
Course Category	Specialization Minor Program Core					
Course title	**Information Theory for Cyber Security**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics					
Course Objectives	The Course is aimed to- 1. Provide a foundation of information theory, basics of random variables, and probability distribution factors. 2. Describe details about secrecy, authentication and block codes 3. Theoretic of security and cryptographic techniques 4. Provide details of secrecy metrics and secure source coding 5. Overview of digital forensics, public key cryptography					
Course Outcomes	After completion of the course, students would be able to: 1. Understand the foundation of information theory, the basics of random variables, and probability distribution factors. 2. Justify details about secrecy, authentication and block codes 3. Explain theoretic of security and cryptographic techniques 4. Analyze secrecy metrics and secure source coding 5. Overview of digital forensics, public key cryptography					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1		1											
CO 2	2	2	1	2	1								2		
CO 3	3	2	1	1	1								2		
CO 4	2	3	2	1	1								2		
CO 5	2	2	2		1								1		

Level of Mapping as: Low 1, Moderate 2, High

Unit No.	Course Content	Hours
I	Shannon's foundation of Information theory, Random variables, Probability distribution factors, Uncertainty/entropy information measures, Leakage, Quantifying Leakage and Partitions, Lower bounds on key size: secrecy, authentication and secret sharing. Provable security, computationally secure, symmetric cipher.	8
II	Secrecy, Authentication, Secret sharing, Optimistic results on perfect secrecy, Secret key agreement, Unconditional Security, Quantum Cryptography, Randomized Ciphers, Types of codes: block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques.	8
III	Information-theoretic security and cryptograph, basic introduction to Diffie-Hellman, AES, and side-channel attacks.	7
IV	Secrecy metrics: strong, weak, semantic security, partial secrecy, Secure source coding: rate-distortion theory for secrecy systems, side information at receivers, Differential privacy, Distributed channel synthesis.	9
v	Digital and network forensics, Public Key Infrastructure, Light weight cryptography, Elliptic Curve Cryptography and applications.	7
Text Books		
i)	Information Theory and Coding, Muralidhar Kulkarni, K S Shivaprakasha, John Wiley and Sons.	
ii)	Communication Systems: Analog and digital, Singh and Sapre, Tata McGraw Hill.	
Reference Books		
i)	Fundamentals in information theory and coding, Monica Borda, Springer.	
ii)	Information Theory, Coding and Cryptography R Bose.	
Iii]	Multi-media System Design, Prabhat K Andleigh and Kiran Thakrar.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Specialization Minor [B. Tech (Computer Science and Technology)] Detailed Curriculum

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 2.2					
Course Category	Specialization Minor Program Core					
Course title	**Data Encryption**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics					
Course Objectives	The Course is aimed to- 1. Provide knowledge of basics of cryptography, and some key encryption techniques. 2. Explain modern cryptosystems and public key cryptography 3. Discuss case studies and security policies such as authentication, integrity and confidentiality, Provide Knowledge of key management and key distribution 4. Introduce the concept of data compression 5. Discuss in detail the entropy encoding 6. Discuss recent trends in encryption and data compression techniques.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Describe basic terminology in cryptography, and classical cryptosystems. 2. Explain modern cryptosystems. concepts of public key cryptography 3. Discuss case studies and analyse security policies such as authentication, integrity and confidentiality and key management and key distribution 4. Understand the concept of data compression 5. Analyse the entropy encoding. 6. Explain recent trends in encryption and data compression techniques.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	1	1		1								1		
CO 2	2	2	1	1	1								1		
CO 3	2	2	1	1	1								1		
CO 4	2	2		1	1										
CO 5	2	2	2	2	1										
CO6	2	2	2	2	2								1		

Level of Mapping as: Low 1, Moderate 2, High

Specialization Minor [B. Tech (Computer Science and Technology)] Detailed Curriculum

Unit No.	Course Content	Hours
I	Introduction to Security: Need for security, Security approaches, Principles of security, Types of attacks. Encryption Techniques: Plaintext, Cipher text, Substitution; Transposition techniques, Encryption; Decryption, Types of attacks, Key range; Size.	7
II	Symmetric ; Asymmetric Key Cryptography: Algorithm types; Modes, DES, IDEA, Differential; Linear Cryptanalysis, RSA, Symmetric; Asymmetric key together, Digital signature, Knapsack algorithm.	6
III	Case Studies of Cryptography: Denial of service attacks, IP spoofing attacks, Conventional Encryption and Message Confidentiality, Conventional Encryption Algorithms, Key Distribution. Public Key Cryptography and Message Authentication: Approaches to Message Authentication, SHA-1, MD5, Public-Key Cryptography Principles, RSA, Digital, Signatures, Key Management, Firewall..	8
IV	Introduction: Need for data compression, Fundamental concept of data compression coding, Communication model, Compression ratio, Requirements of data compression, Classification. Methods of Data Compression: Data compression-- Loss less; Lossy.	7
v	Entropy encoding-- Repetitive character encoding, Run length encoding, Zero/Blank encoding; Statistical encoding-- Huffman, Arithmetic ; Lempel-Ziv coding; Source encoding-- Vector quantization (Simple vector quantization ; with error term).	7
vi	Recent trends in encryption and data compression techniques.	4
	Text Books	
i)	Cryptography and Network Security, Mohammad Amjad, John Wiley and Sons.	
ii)	Cryptography and Network Security by Atul Kahate, TMH.	
	Reference Books	
i)	Information Theory and Coding, Muralidhar Kulkarni, K S Shivaprakasha, John Wiley and Sons.	
ii)	Cryptography and Network Security by B. Forouzan, McGraw-Hill.	
Iii]	The Data Compression Book by Nelson, BPB.	
	Assessment	
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Specialization Minor [B. Tech (Computer Science and Technology)] Detailed Curriculum

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 2.3					
Course Category	Specialization Minor Program Core					
Course title	**Security Assessment and Risk Analysis**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Basic Mathematics					
Course Objectives	The Course is aimed to- 1. Describe the concepts of security basics, critical information characteristics, and security countermeasures in information security. 2. Explain threats to the system and vulnerabilities of the system. Study concepts of risk management 3. Study security planning and procedures, contingency planning and disaster recovery. 4. Describe concepts of security practices and auditing and monitoring 5. Study operation security concepts and case study to analyse threats and vulnerabilities in the system					
Course Outcomes	After completion of the course, students would be able: 1. Understand Information security basics, critical information characteristics, and security countermeasures. 2. Analyze threats to the system and vulnerabilities of the system and design risk management framework accordingly 3. Plan security practices, contingency planning and disaster recovery 4. Analyze personal security practices and procedure and auditing and monitoring security programs 5. Understand concept of operation security and planning and assess the system with the help of latest tools and technology for threats and vulnerability					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-											
CO 2	2	3	2	3	2								2		
CO 3	2	3	2	2	2						1				
CO 4	2	3	2	3	3								2		
CO 5	2	3	2	2	3								2		

Level of Mapping as: Low 1, Moderate 2, High

Specialization Minor [B. Tech (Computer Science and Technology)] Detailed Curriculum

Unit No.	Course Content	Hours
I	SECURITY BASICS: Information Security (INFOSEC) Overview: critical information characteristics – availability information states – processing security countermeasures-education, training and awareness, critical information characteristics confidentiality, critical information characteristics– integrity,information states – storage, information states – transmission, security countermeasures-policy, procedures and practices, threats, vulnerabilities.	8
II	Threats to and Vulnerabilities of Systems: Threats, major categories of threats (e.g., fraud, Hostile Intelligence Service (HOIS). Countermeasures: assessments (e.g., surveys, inspections). Concepts of Risk Management: consequences (e.g., corrective action, risk assessment), cost/benefit analysis and implementation of controls, monitoring the efficiency and effectiveness of controls (e.g., unauthorised or inadvertent disclosure of information).	8
III	Security Planning: directives and procedures for policy mechanism. Contingency Planning/Disaster Recovery: agency response procedures and continuity of operations, contingency plan components, determination of backup requirements, development of plans for recovery actions after a disruptive event.	7
IV	Personnel Security Practices and Procedures: access authorisation/verification (need-to-know), contractors, employee clearances, position sensitivity, security training and awareness, systems maintenance personnel. Auditing and Monitoring: conducting security reviews, effectiveness of security programs, investigation of security breaches, privacy review of accountability controls, review of audit trails and logs.	7
v	Operations Security (OPSEC): OPSEC surveys/OPSEC planning INFOSEC: computer security – audit, cryptography-encryption (e.g., point-to-point, network, link).	6
vi	Case study of threat and vulnerability assessment.	3
Text Books		
i)	Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, John Wiley ; Sons.	
ii)	Principles of Incident Response and Disaster Recovery, Whitman ; Mattord, Course Technology ISBN: 141883663X.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. 10 marks will be given based on the assignments on each unit. It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">Specialization Minor, I, 4th Semester onwards</td></tr>
<tr><td>Course Code</td><td colspan="7">SPM 2.4</td></tr>
<tr><td>Course Category</td><td colspan="7">Specialization Minor Based Internship</td></tr>
<tr><td>Course Title</td><td colspan="7">Cyber Security Related Internship</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td colspan="5">One Month</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td>00</td><td>00</td><td>50</td><td>-</td><td>50</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">Basics of unit processes and unit operations.</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The Industrial Internship course caters specifically to B.Tech Computer Science and Technology students pursuing additional specialization through the B.Tech Minor program in areas such as Cyber Security. This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in specialized sectors of Computer Science and Technology.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The course teacher will
1. Help expose students to the 'real' working environment;
2. Promote hands-on experience to the students’ in their related field;
3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society;
4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made.
5. Elaborate the dynamic and challenging nature of industrial environments.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">Upon completion of this course, student should be able to
1. Understand industrial processes and operations related to their minor sub-specializations.
2. Apply theoretical concepts to solve practical problems in the industry.
3. Communicate effectively with industry professionals, colleagues, and supervisors.
4. Collaborate efficiently in team environments to complete tasks and projects.
5. Adapt to the dynamic and challenging nature of industrial environments.
6. Reflect on internship experiences for personal and professional growth.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	3	-	-	-
CO 5	-	-	-	-	-	2	-	-	-	-	-	3
CO 6	-	-	-	-	-	-	-	-	-	-	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The course consists of a one-month internship with respect to Cyber Security. Students will be placed in companies or organizations that align with the particular requirement. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.

- The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards						
Course Code	SPM 2.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of Computers and programming						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena .						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical

problems. The project work need to be carried out independently covering a range of topics relevant to their field of study allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

- Rubric-based assessment for the project work and its report.
- Peer evaluation for project.
- Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
- Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Specialization Minor
In
Data Science
For
B.Tech (Computer Science and Technology)

Shivaji University, Kolhapur
Department of Technology

Specialization Minor in Data Science

Teaching & Evaluation Scheme

Sr. No.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	SPM 3.1	Introduction to Data Science	03	-	-	03	03	30:70	00:00
2.		SPM 3.2	Introduction to AI and ML	03	-	-	03	03	30:70	00:00
3.		SPM 3.3	Computational Data analytics	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	SPM 3.4	Data Science Related Internship	One Month				03	-	50:50
5.	Project Based Learning	SPM 3.5	Mini Project	-	-	-	-	02	-	50:50
				-	-	-	-	14	300	200
			Total Hours	09	00	00	09	-	-	-

Note: If opted the Specialization Minor Program, Internship and Mini Project may be planned during winter or summer vacation days after 4th semester while respective evaluations will appear on a separate mark sheet.

Specialization Minor III: Data Science

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 3.1					
Course Category	Specialization Minor Program Core					
Course title	**Introduction to Data Science**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	EE	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Database Engineering					
Course Objectives	The Course is aimed to- 1. Provide the knowledge and expertise to become a proficient data scientist. 2. Demonstrate an understanding of statistics and machine learning concepts thatare vital for data science. 3. Produce Python code to statistically analyse a dataset. 4. Critically evaluate data visualizations based on their design and use forcommunicating stories from data.					
Course Outcomes	After completion of course, students would be able: 1. To explain how data is collected, managed and stored for data science. 2. To understand the key concepts in data science, including their real-worldapplications and the toolkit used by data scientists. 3. To implement data collection and management scripts using MongoDB.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1												
CO 2		2	2		3		2								
CO 3				2	2	3		3							

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science.	7
II	Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.).	7
III	Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms	9
IV	Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.	9
V	Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.	7
Text Books		
i	Business Analytics: The Science of Data - Driven Decision Making, U Dinesh Kumar, John Wiley & Sons.	
ii	Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, John Wiley & Sons.	
Reference Books		
i	Joel Grus, Data Science from Scratch, Shroff Publisher/O'Reilly Publisher Media	
ii	Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher	
iii	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher.	
iv	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.	
v	Jake VanderPlas, Python Data Science Handbook, Shroff Publisher/O'Reilly Publisher Media.	
vi	Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher/O'Reilly Publisher Media.	
Lab work		
i	Python Environment setup and Essentials.	
ii	Mathematical computing with Python (NumPy).	
iii	Scientific Computing with Python (SciPy).	
iv	Data Manipulation with Pandas.	
v	Prediction using Scikit-Learn	
vi	Data Visualization in python using matplotlib	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination	

	will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work.** It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 3.2					
Course Category	Specialization Minor Program Core					
Course title	**Introduction to AI and ML**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Database, networking, Basic Mathematics					
Course Objectives	The Course is aimed to- 1. Understand basics of machine learning in data science. 2. Understand various basic machine learning algorithm that can be used with various type of data.					
Course Outcomes	After completion of course, students would be able: 1. To explain how data is collected, managed and stored for data science. 2. To use various type of Machine learning model. 3. To implement various ML algorithms on data models.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1												
CO 2				2	2										
CO 3					2	2	2								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Linear Regression: Basic facts of linear regression, implementation of linear regression, case studies of linear regression using data set.	6
II	Logistic Regression: Basic facts and implementation of logistic regression, solve a case study to predict output using existing data set.	8
III	Clustering and Principle Component Analysis: K means and hierarchical clustering, how to make market strategies using clustering, recommendation and PCA	9
IV	Support Vector Machine: basics of SVM and use it to detect the spam emails and recognize alphabets.	8
V	Model Selection and advanced regression: use of Lasso and Ridge	8
Text Books		
i	Machine Learning using Python , U Dinesh Kumar and Manaranjan Pradhan, John Wiley & Sons.	
ii	Advanced Data Analytics Using Python: With Machine Learning, Deep Learning by By Sayan Mukhopadhyay, Apress.	
iii	Practical Data Mining" by Monte F. Hancock, Auerbach Publication.	
iv	"Machine Learning for Absolute Beginners: A Plain English Introduction (Second Edition)" by Oliver Theobald.	
Reference Books		
i	Practical Data Science with R, Nina Zumel, John Wiley & Sons	
ii	Python for Data Science for Dummies, John Paul Mueller, Luca Massaron, John Wiley	
iii	Big Data and Analytics, Seema Acharya and Subhashini Chellappan, Wiley Publication.	
Lab work		
i	Use python to predict employee attrition in a firm and help them plan their manpower. (take data set from kaggle).	
ii	Create customer clusters using different market strategies on a data set.	
iii	Make a movie recommendation system.	
iv	Develop a prediction mechanism to predict which employee can go on leave in a company in near future.	
v	Recognizing alphabets using SVM.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work.** It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work.	

	b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards					
Course Code	SPM 3.3					
Course Category	Specialization Minor Program Core					
Course title	**Computational Data Analytics**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**		**ESE**	**IE**	**EE**	**Total**
	30		70	00	00	100
Pre-requisites(if any)	Introduction to Data Science, Introduction to AI and ML					
Course Objectives	The Course is aimed to- 1. Learn how to think about your study system and research question of interest in asystematic way in order to design an efficient sampling and experimental research program. 2. Understand how to analyze collected data to derive the most information possibleabout your research questions.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain how data is collected, managed and stored for data science 2. When to use which type of Machine learning model. 3. Implement various ML algorithms on data models.					

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	1												
CO 2				2	2										
CO 3					2	2	2								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to R Computing language. Best practices in executing Reproducible Research in data science, Sampling and Simulation. Descriptive statistics, and the creation of good observational sampling designs.	6
II	Data visualization, Data import and visualization, Introduction to various plots.	8
III	Frequentist Hypothesis Testing, Z-Tests, Power Analysis	8
IV	Linear regression, diagnostics, visualization, Likelihoodist Inference, Fitting a line with Likelihood, Model Selection with one predictor	9
V	Bayesian Inference, Fitting a line with Bayesian techniques, Multiple Regression and Interaction Effects, Information Theoretic Approaches	8
Text Books		
i	Practical Data Science with R, Nina Zumel, John Wiley & Sons.	
ii	N. C. Das, Experimental Designs in Data Science with Least Resources, Shroff Publisher Publisher..	
Reference Books		
i	Hadley Wickham, Garret Grolemund, R for Data Science, Shroff Publisher/O'Reilly Publisher Publisher	
ii	Benjamin M. Bolker. Ecological Models and Data in R. Princeton University Press, 2008. ISBN 978-0-691-12522-0.	
iii	John Fox and Sanford Weisberg. An R Companion to Applied Regression. Sage Publications, Thousand Oaks, CA, USA, second edition, 2011. ISBN 978-1-4129-7514-8.	
Lab work		
i	To give a basic insight of R and its various libraries.	
ii	Libraries in R. R as a Data Importing Tool, Dplyr. Forcats.	
iii	Simulation and Frequentist Hypothesis testing, Simulation and Power.	
iv	Bayesian computation in R, Fitting a line with Bayesian techniques.	
Assessment		
	a) ISE has a total weightage of 30 marks which is a (20+10) marks pattern. Theory paper examination will be conducted at central level for 20 marks. **10 marks will be given based on the assignments of lab work.** It consists of assignments, quiz, seminars, presentations, research papers and research articles, developing working models, surveys and activities related to course as designed by the course coordinator to suit the needs of the course and to complement program outcomes. The practical work and its journal is not part of course work. b) ESE will be conducted at central level at the end of the semester. It will be theory paper for 100 Marks and then it will be scaled down for 70 marks.	

Year, Program, Semester	Specialization Minor I, 4th Semester onwards						
Course Code	SPM 3.4						
Course Category	Specialization Minor Based Internship						
Course Title	**Data Science Related Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	The Industrial Internship course caters specifically to B.Tech Computer Science and Technology students pursuing additional specialization through the B.Tech Minor program in areas such as Cyber Security. This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in specialized sectors of Computer Science and Technology.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment; 2. Promote hands-on experience to the students' in their related field; 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society; 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	-	-	-	-	-	-	-	3	-	-	-
CO 5	-	-	-	-	-	2	-	-	-	-	-	3
CO 6	-	-	-	-	-	-	-	-	-	-	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The course consists of a one-month internship with respect to Cyber Security. Students will be placed in companies or organizations that align with the particular requirement. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
    - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
    - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
    - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
    - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Year, Program, Semester	Specialization Minor I, 4th Semester onwards						
Course Code	SPM 2.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00	50	-	50	-	100
Pre-requisites(if any)	Basics of Computers and programming						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena .						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:
• Rubric-based assessment for the project work and its report.
• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.
The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.