Integrated B. Tech. (Artificial Intelligence) and M. Tech. (Artificial Intelligence)

Sr.	Subject	Code	Scheme	Credits	Notional
No.			L-T-P	(Min.)	Hours of
					Learning
					(Approx.)
	First Semester (1 <sup>st</sup> year of IPG)	1			
1	Fundamentals of Computer and Programming	IA101	3-0-2	4	85
2	Fundamentals of Engineering Mathematics	MA105	3-1-0	4	70
3	Linear Algebra and Statistics	MA116	3-1-0	4	70
4	English and Professional Communication	HS110	3-1-0	4	70
5	Basic Electrical and Electronic Engineering	IA105	3-0-2	4	85
			Total	20	380
6	Vocational Training/Professional Experience	IAV01/	0-0-10	5	200
	(Optional) (Mandatory for Exit)	IAP01			(20x10)
	Second Semester (1 <sup>st</sup> year of IPG)				
1	Data Structures	IA102	3-0-2	4	100
2	Object Oriented Programming	IA108	3-0-2	4	85
3	Energy and Environmental Engineering	EG110	3-0-2	4	85
4	Discrete Mathematics	MA106	3-1-0	4	70
5	Digital Electronics and Logic Design	EC106	3-0-2	4	85
6	Indian Value System and Social Consciousness	HS120	2-0-0	2	35
			Total	22	460
7	Vocational Training/Professional Experience	IAV02/	0-0-10	5	200
	(Optional)(Mandatory for Exit)	IAP02		3/3/1	(20x10)
	Third Semester (2 <sup>nd</sup> year of IPG)				
1	Computer Organization	IA201	3-0-0	3	70
2	Database Management Systems	IA203	3-0-2	4	85
3	Design and Analysis of Algorithms	IA205	3-1-0	4	70
4	Signals and Systems	EC203	3-1-0	4	70
5	Automata and Formal Languages	IA211	3-1-0	4	70
			Total	23	365
	Fourth Semester (2 <sup>nd</sup> year of IPG)				
1	Artificial Intelligence	IA202	3-1-0	4	85
2	Operating Systems	IA204	3-0-2	4	85
3	Machine Learning	IA206	3-0-2	4	85
4	Computer Networks	IA208	3-0-2	4	85
5	Data Science	IA212	3-0-0	3	70
			Total	19	410
7	Minor/Honor (M/H#1)	IA2AA	3-X-X	3/4	55/70/85
8	Vocational Training/Professional Experience	IAV04/	0-0-10	5	200
1	(Optional)(Mandatory for Exit)	IAP04			(20x10)
	Fifth Semester (3 <sup>rd</sup> year of IPG)				
1	Deep Learning	IA301	3-0-2	4	85
2	Cloud Computing	IA303	3-0-2	4	85
3	Information Security and Cryptography	IA309	3-1-0	4	70

Subject Code:##nXX; ##: Department Identity, n:Year,XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01to30 –last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject, SC: Science Subject (offered combinedly by departments)(SVNIT Surat)

Lovered

Mondo

My grown

D M

4	Elective	IA3AA	3-X-X	3	55/70/85		
5	Elective (Specialization#1)	IA3BB	3-X-X	3	55/70/85		
6	Linear and Nonlinear Optimization	IA307	3-1-0	4	70		
		,	Total	22	420-480		
7	Minor/Honor (M/H#2)	IA3CC	3-X-X	4	70/85		
	Sixth Semester(3 <sup>rd</sup> year of IPG)						
1	High Performance Computing	IA302	3-0-2	4	85		
2	Cyber Physical System	IA304	3-0-2	4	85		
3	Big Data Analytics and Visualization	IA306	3-0-2	4	85		
4	Elective	IA3DD	3-X-X	3	55/70/85		
5	Elective (Specialization#2)	IA3EE	3-X-X	3	55/70/85		
6	Image Processing and Computer Vision	IA308	3-0-2	4	85		
			Total	22	450-510		
7	Minor/Honor (M/H#3)	IA3FF	3-X-X	3/4	70/85		
8	Vocational Training/Professional Experience	IAV06/	0-0-10	5	200		
	(Optional) (Mandatory for Exit)	IAP06		,	(20x10)		
	Seventh Semester (4 <sup>th</sup> year of IPG)						
1	Research Methodology	IA403	1-1-0	2	35		
2	Robotics and Applications	IA405	3-0-2	4	85		
3	Elective	IA4BB	3-X-X	3	55/70/85		
4	Elective (Specialization#3)	IA4CC	3-X-X	3	55/70/85		
5	Elective (Specialization#4)	IA4DD	3-X-X	3	55/70/85		
6	Minor Project-I	IA407	0-0-10	5	150		
			Total	20	435-525		
8	Minor/Honor (M/H#4)	IA4EE	3-X-X	3/4	55/70/85		
	Eighth Semester (4 <sup>th</sup> year of IPG)						
1	Intelligent Multiagent and Expert Systems	IA402	3-0-2	4	85		
2	Professonal Ethics, Business and Entrepreneurship	HUXXX	3-0-0	3	70		
3	Human Computer Interaction	IA404	3-0-0	3	70		
4	Elective	IA406	3-X-X	3	55/70/85		
5	Elective	IA408	3-X-X	3	55/70/85		
6	Minor Project-II	IA412	0-0-10	5	150		
			Total	21	485-545		
	Ninth Semester (5 <sup>th</sup> year of IPG)						
1	MOOC-I	IA501	2-0-0	2	35		
2	M.Tech. Thesis Part-I	IA505	0-0-36	18	540		
			Total	20	575		
	Tenth Semester (5 <sup>th</sup> year of IPG)						
1	M.Tech. Thesis Part-II	IA502	0-0-40	20	600		
100	era-consequents attraconcer statements	96376 935 935 8	Total	20	600		

M. Lamis, Hymrs

In housen P

The

Subject Code:##nXX; ##: Department Identity, n:Year,XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01to30 –last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject, SC: Science Subject (offered combinedly by departments)(SVNIT Surat)

Integrated B.Tech.+M.Tech. I (AI) Semester – I FUNDAMENTAL OF COMPUTER AND PROGRAMMING	Scheme	L	T	Р	Credit
IA101	and the second	3	0	2	04

Course Outcomes (COs): At the end of the course, students will be able to
Understand the basic concepts of computers and programming.
Apply the knowledge of C Programming to solve computational problems.
Debug, test, and analyse C Programs to find and correct errors and improve the solutions.
Learn various programming techniques such as iteration and recursion, and apply them to solve computational problems.
Learn and apply the advanced programming concepts such as modularization, memory management, and file handling to improve the efficiency of computational problems.

2.	Syllabus				
	INTRODUCTION TO COMPUTER ARCHITECTURE AND OPERATING SYSTEM	(05 Hours)			
-	Computer Architecture, Input unit, Output unit, Storage Unit, Central Processing Unit, Introduction of Operating System, Function OS, Unix Commands.				
	OVERVIEW OF C PROGRAMMING LANGUAGE	(04 Hours)			
	Concepts Of High-Level, Assembly And Low-Level Languages, History of C, Importance of Algorithms through Pseudocode and Flowchart, Basic Structure of a C Program, How Program, How to Run a C Program, Sample Programs.				
	CONSTANTS, VARIABLES, AND DATA TYPES	(02 Hours)			
	Character Set in C, Keywords, Identifiers, Constants, Strings, Operators, Special Symbols, Variables, Data Types: Primary Data Types and User Defined Data Types, Declaration of Variables, Assigning Values to Variables, Initialization of Variables, Defining Symbolic Constants, Declaring Variables as Constants.				
	OPERATORS, EXPRESSIONS AND LIBRARY FUNCTIONS	(04 Hours)			
	Operators: Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Cond Comma Operator, sizeof Operator, Operators used in Pointers and Structures, Arithmet How C programming Evaluates Arithmetic Expressions, Precedence of Arithmetic Associativity Rule, Type Conversion: Implicit and Explicit. Reading Character from Key Character on Screen, Reading String from Keyboard, Printing String on Screen, Forma	tic Expressions, Operators and board, Printing			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Providence Many

Output, Math Functions. DECISION MAKING, BRANCHING, AND LOOPING (06 Hours) Decision Making in C Programming, If Statement, Nested If Statement, Else If Ladder, Switch Statement, Conditional Operator Statement, Goto Statement, Decision Making with Logical Operators, Sample Programs. Introduction to Loops, While Loop, Do While Loop, For Loop, Break Statement, Goto Statement, Continue Statement, Sample Programs. ARRAYS AND CHARACTER ARRAYS (05 Hours) Introduction to Arrays, One Dimensional Array, Declaration and Initialization of One Dimensional Array, Two Dimensional Array, Declaration and Initialization of Two Dimensional Array, Multi-Dimensional Array, Sample Programs, Declaration and Initialization of Strings, Arithmetic Operations on Characters, String Functions: Strlen(), Strcat(), Strcpy(), Strstr(), Strcmp(), etc. **FUNCTIONS** (05 Hours) Function Declaration, Function Definition, Function Calls, Functions with No Arguments and No Return Values, Functions with Arguments and No Return Values, Functions with No Arguments and Return Values, Functions with Arguments and Return Values, Recursive Functions, Passing Arrays to Functions, Call by Value, Call by Reference, Scope and Lifetime of Functions: Local, Global, Static, and Register Declaration. STRUCTURES AND UNIONS (04 Hours) Structure Template, Structure Variable Declaration and Initialization, Structure Variable Assignment, Accessing Structure Variables, Arrays as Structure, Arrays with Structures, Passing Structure Members to Functions, Unions, Difference Between Structures and Unions, Bit Fields. POINTERS AND MEMORY MANAGEMENT (05 Hours) Declaration and Initialization of Pointers, Accessing Memory through Pointers, Pointer to Pointer, Pointer Arithmetic, Dynamic Memory Allocation, Memory Management Functions: Malloc, Calloc, and Free, Using Pointers to Access Dynamically Allocated Memory Locations, Pointers with Arrays, Function and Structure, Use of Pointers to Return Multiple Values From Functions. FILE MANAGEMENT AND PREPROCESSOR (05 Hours) Opening and Closing a File, Modes in File Opening: Read, Write and Append, Input and Output, Operations on Files, File Handling Functions such as fseek(), ftell(), rewind(). Pre-processor directives, Macro Substitution, Importing a File, Compiler Control Directives, Command Line arguments Practicals will be based on the coverage of the above topics separately. (30 Hours)

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Providen, Provident MP 201

(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)

3.	Practical
1	C Programming – How to write a program, compile a program, and execute a program
2	Read the input from a keyboard and write the output to computer screen
3	Variable declaration, initialization, and assignment, Constant declaration, Experiments with different data types
4	Experiments with different C Operators, Analysing the impact of precedence and associativity rules while evaluating expressions in C
5	Experiments with standard library functions related to math library, time library, standard input and output library etc.
6	Experiments with If, Else If, Switch, Goto statements
7	Experiments with While, DoWhile, For Loops, and analysing the impact of Break, Goto and Continue statements on C Loops
8	Experiments with Arrays and Character Arrays
9	Experiments with Different Functions having Arguments/No Arguments and Return Values/No Return Values, Scope and Lifetime of Functions, and Understanding Local, Global, Static, and Register Declaration
10	Experiments with Structures and Unions, Analysing the difference between the structure and union with respect to memory
11	Experiments with Pointers with respect to Accessing Memory from the Stack and Heap Section of the RAM (i.e., Experiments with Static and Dynamic Memory Management)
12	Opening, Closing the Files using a C program, and accessing the files to get the input from the file and store the output to the file.
13	Experiments with pre-processor directives.

4.	Books Recommended
1.	Introduction to Computer Science", Fourth Impression, Pearson Education, ITL EducationSolutions Limited, 2009.
2.	Nell Dale and John Lewis, "Computer Science Illuminated", Jones and Bartlett Publishers.
3.	E. Balagurusamy, "Programming in ANSI C", Mc-Graw Hill.
4.	Brian W. Kernighan / Dennis Ritchie, "The C Programming Language", Pearson.
5.	Yashavant Kanetkar, "Let us C", BPB Publications.
6.	Harbison and Steele, "C: A Reference Manual"

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Provens Joseph Try De

Integrated B.Tech.+M.Tech. I (AI) Semester – I FUNDAMENTALS OF ENGINEERING MATHEMATICS	Scheme	L.	Т	Р	Credit
MA105		3	1	0	04

1.	Course Outcomes (COs):
	At the end of the course, the students will be able to
CO1	Accept the challenge to solve the problem with Mathematics.
CO2	Apply the knowledge of curve tracing to solve problem of engineering.
CO3	Identify, formulate and analyze complex engineering and affiliated field problems, specifically the differential equation concept in different engineering field.
CO4	Apply the knowledge of mathematics for model and analyze computational processes using analytic and combinatorial methods
CO5	Design solutions engineering industrial problems with effective mathematical skill.

2.	Syllabus	
	DIFFERENTIAL CALCULUS	(09 Hours)
	Differentiation of Hyperbolic and Inverse Hyperbolic functions. Successive Differential forms, Leibnitz's theorem and applications, Power series, Expansion of functions, Maclaurin's series. Curvature, Radius of curvature for Cartesian curve with application.	
	PARTIAL DIFFERENTIAL CALCULUS	(09 Hours)
	Partial differentiation, Euler's theorem for homogeneous function, Modified Euler's the and Maclaurin's series for two variables. Tangent plane and Normal line, Error and A Jacobians with properties, Extreme values of function of two variables, Lagrange's undetermined multipliers.	pproximation
	CURVE TRACING	(06 Hours
	Cartesian, polar and parametric form of standard curves.	
	ORDINARY DIFFERENTIAL EQUATION	(09 Hours
	Reorientation of differential equation first order first degree, exact differential Integrating factors, first order higher degree odes, solvable for p, y and x, Solution of equations higher order, complementary functions, Particular Integrals, Linear differential with variable coefficient, Cauchy's Euler and Legendre's equation with variable coefficient, variation of parameters.	homogenous
	APPLICATION OF DIFFERENTIAL EQUATION (MATHEMATICAL MODELLING)	(06 Hours
	Modelling of Realworld problems particularly Engineering System, Electrical network spread of epidemic (SI, SIS, SIR), Newton's Law of cooling, Compartment modelling, Bermodels.  Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Signal Core)	nding of bean ast digit 0 or ODD and

for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject,

SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

P

Provident, Mfr.

SERIES SOLUTION AND SPECIAL FUNCTIONS	(06 Hour
Regular point, Singular point, series solution of ODE of 2nd order with variable emphasis to differential equation of Legendre's and Bessel's for different ca equations.	
Tutorials will be based on the coverage of the above topics separately.	(15 Hour
lutorials will be based on the coverage of the above tonics senarately	(15

3.	Tutorials	
1	Tutorial will be related to Differential Calculus.	
2	Tutorial will be on Radius of curvature for Cartesian curve with application.	
3	Tutorial will be on different examples of Partial Differential Calculus.	
4	Tutorial will be on Extreme values of function of two variables.	
5	Tutorial will be on Curve Fitting.	
6	Tutorial will cover Ordinary differential equations.	
7	Tutorial will be on examples of Higher order Ordinary differential equations.	
8	Tutorial will be on examples of Application of Ordinary differential equations.	
9	Tutorial will be on Series solution with ordinary point	
10	Tutorial will be on with Series solution with regular singular point	

4.	Books Recommended	
1	James Stewart, "Calculus", Thomson Asia, Singapore, 2003.	
2	Kreyszing E., "Advanced Engineering Mathematics", John Wiley & Sons, Singapore, Int. Student Ed. 2015.	
3	Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed. 1993.	
4	F. B. Hilderband, "Methods of Applied mathematics", PHI, New Delhi, 1968	
5	Ramana D. V., "Higher Engg. Mathematics", The McGraw-Hill Inc., New Delhi, 2007.	

#### ADDITIONAL REFERENCE BOOKS

1 Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi, 2015.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



Provier Lauer Lauer

2	Bali and Iyengar, "Engineering Mathematics", Laxmi Publications, New Delhi, 2004.
3	Mary L. Boas, "Mathematical Methods in the Physical Sciences", John Wiley & Sons, Ed.2005

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



Provident Locust

Integrated B.Tech.+M.Tech. I (AI) Semester – I	Scheme	L	Т	Р	Credit
LINEAR ALGEBRA AND STATISTICS	and the second second	2	1	0	0.4
MA116		3	1	U	04

1.	Course Outcomes (COs): At the end of the course, students will be able to	
CO1	accept the challenge to solve the problem with statistics	
CO2	apply the knowledge of Linear Algebra to solve problem of engineering.	
CO3	identify, formulate and analyze complex engineering and affiliated field problems, specifically Partial differential equation concept in different engineering field	
CO4	apply the knowledge of vector calculus and analyze computational processes	
CO5	design solutions to work on engineering industrial problems with effective mathematical skill.	

2.	Syllabus			
	PROBABILITY THEORY AND RANDM PROCESS	(09 Hours)		
	Fundamentals of Probability Theory: - views of probability, Random variables and Joint Marginal distribution, Conditional probability, Conditional independence, Expectation Probability distributions Central limit theorem, Functions of random variable, Sum of random variable, Correlation and regression, Random process, Stationary rand Autocorrelation and cross correlation, Ergodic process, Markov process, Birth and de Poisson process, Markov chain, Chapman Kolmogorov theory, Spectral analysis of rando power spectral density.	and variance, independent lom process, eath process,		
	ESTIMATION AND STATISTICS			
	Sampling theory, Population and sample, Statistical interference, Sampling distribution, Bias estimation, Unbiased estimator, Confidence interval, Point estimation and interstatistical decision, Hypothesis testing, Statistical hypotheses, Null hypotheses, Significant and types II errors, Level of significance, One tail and two tailed test, Chi square to likelihood estimate, Least square estimate, MAP estimate, Minimum mean square estimate.	val estimates, ice test, Type I est, Maximum		
	INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATION	(09 Hours)		
Introduction to Partial differential equation, Formation of partial differential Equation differential Equation of first order, Linear partial differential equation of first order (Pp + 0 method of obtaining its general solution, Non-linear partial differential equation of first q)=0, $f(z, p, q)=0$ , $f(x, p)=g(y, q)$ , $z=px+qy+f(p,q)$ .	+ Qq = R) and			
BASIC CONCEPTS OF VECTOR CALCULUS		(08 Hours)		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

P

Proven Lacent with notes

	Tutorials will be based on the coverage of the above topics separately.	(15 Hours)
ACCOUNT OF THE PARTY OF THE PAR	Linear systems, Elementary row and column transformation, rank of matrix, or system of equations, Linear Independence and Dependence of vectors, Gauss I Gauss-Jorden Method, Gauss-Jacobi Iteration Method; Vector spaces, Subspace, Fi distance, Linear Mapping, Orthogonality, Eigenvectors and Eigenvalues, Least sedata fitting, Constrained least square applications.	Elimination method ield, Ring, Norm and
-	LINEAR ALGEBRA	(11 Hours)
	Scalar and vector point function, differential operator, gradient, directional derivat and Laplacian operator with their properties.	ive, divergence, curi

3.	Tutorials
1	Tutorial will be related to Probability theory.
2	Tutorial will be on Randomness.
3	Tutorial will be on Estimation theory.
4	Tutorial will be on Partial differential Equation.
5	Tutorial will be on special type of Partial differential Equation.
6	Tutorial will covered on basics of Vector calculus.
7	Tutorial will be on examples of divergence, curl and Laplacian operator.
8	Tutorial will be on examples Liner algebra.
9	Tutorial will be on Eigenvectors and Eigen values.
10	Tutorial will be on Least square, Least square data fitting, Constrained least square applications

3.	Books Recommended
1	Kreyszing E., "Advanced Engineering Mathematics", John Wiley & Sons, Singapore, Int. Student Ed. 2015.
2	Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed. 1993.
3	Gilbert Strang, "Introduction to Linear Algebra", Wellesley Cambridge Press, 4th Ed., 2009.
4	David C. Lay, "Linear Algebra and its applications", 3rd Ed., Pearson, 2006.
5	A. Papoulis and S. U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Ed., Mc-

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, Proven Lower Mins SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Graw Hill, 2002.		

AD	DITIONAL REFERENCE BOOKS
1	Ramana D. V., "Higher Engg. Mathematics", McGraw-Hill Inc., New Delhi, 2007.
2	Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi, 2015.
3	Mary L. Boas, "Mathematical Methods in the Physical Sciences", John Wiley & Sons, Ed.2005.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

P

graveen

Integrated B.Tech.+M.Tech. I (AI) Semester – I ENGLISH AND PROFESSIONAL COMMUNICATION	Scheme	L	Т	Р	Credit
HS110		3	1	0	04

1.	Course Outcomes (COs): At the end of the course, the students will be able to	
CO1	show enhanced reception towards the use of English language.	
CO2	choose and employ appropriate words for professional communication.	
CO3	develop sentences and text in English coherently and formally.	
CO4	demonstrate overall improvement in oral communication.	
COS	analyze and infer from written and oral messages.	

2.	Syllabus				
	COMMUNICATION	(05 Hours)			
	Introduction to Communication, Different forms of Communication, Barriers to Communication and some remedies, Non-Verbal Communication — Types, Non-Verbal Communication in Intercultural Context.				
	VOCABULARY AND USAGE OF WORDS	(05 Hours)			
	Common Errors, Synonyms, Antonyms, Homophones, and Homonyms; Substitution; Misappropriations; Indianisms; Redundant Words.	One Word			
	LANGUAGE THROUGH LITERATURE	(09 Hours)			
	Selected short stories, essays, and poems to discuss nuances of English language.				
	LISTENING AND READING SKILLS	(06 Hours)			
	Types of listening, Modes of Listening-Active and Passive, Listening and note taking practice, Practice and activities Reading Comprehension (unseen passage- literary /scientific/technical) Skimming and scanning, fact vs opinion, Comprehension practice				
	SPEAKING SKILLS	(10 Hours)			
		tonious			
	Effective Speaking, JAM, Presentation Skills- types, preparation and practice. In types, preparation and mock interview; Group Discussion- types, preparation and				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



Process Man

Prerequisites of effective writing, Memo-types, Letter Writing- types, Email e Netiquette, Résumé-types, Report Writing and its types, Editing.	tiquette and
 Tutorials will be based on the coverage of the above topics separately	(15 Hours)
(Total Contact Time: 45 Hours + 15 Ho	ours = 60 Hours)

3.	Tutorials
1	Letter and Resume
2	Group Discussion
3	Presentation Skills (Individual)
4	Role Play on Nonverbal communication
5	Group Presentation
6	Debate
7	Body language and intercultural communication
8	Listening Activities
9	Editing
10	Report Writing
11	Mock interviews
12	JAM

4.	Books Recommended
1	Kumar, Sanjay and Pushp, Lata. Communication Skills, 2nd Edition, OUP, New Delhi, 2015.
2	Raman, Meenakshi & Sharma Sangeeta. <i>Technical Communication Principles and Practice</i> , 3 <sup>rd</sup> Edition, OUP, New Delhi, 2015.
3	Raymond V. Lesikar and Marie E Flatley. <i>Basic Business Communication skills for Empowering the Internet generation</i> . Tata McGraw Hill publishing company limited. New Delhi 2005.
4	Courtland L. Bovee, John V. Thill, and Mukesh Chaturvedi. "Business Communication Today." Ninth Edition. Pearson, 2009.
5	Mike Markel. "Practical Strategies for Technical Communication," Bedford/St. Martin's Second Edition, 2016
6	Laura J. Gurak and John M. Lannon. "Strategies for Technical Communication in the Workplace," Pearson, 2013.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, Provedo Mynds SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG I (AI) Semester – I BASIC OF ELECTRICAL AND ELECTRONICS ENGINEERING		L	Т	Р	Credit
IA105		3	0	2	04
	Scheme				

_	ourse Outcomes (COs):
At the	end of the course, students will be able to
CO1	Understand Basic Electrical Concepts – Explain circuit components, Ohm's law, Kirchhoff's laws, and AC/DC circuit behavior.
CO2	Analyze Circuits Using Network Theorems – Apply Thevenin's, Norton's, Superposition, and other theorems for circuit analysis.
CO3	Analyze single-phase AC circuits and compute electrical quantities using RMS, average values, and power factor concepts.
CO4	Explain the working principles and characteristics of semiconductor devices and integrated circuits, and apply them in designing basic analog electronic circuits including amplifiers, oscillators, multivibrators, and timer-based applications.
CO5	Use Electrical Measurement Instruments – Operate multimeters, oscilloscopes, and transducers for measuring electrical parameters.

2.	Syllabus	
	Basic Electrical Engineering Concepts, Laws and Principles	(07 Hours)
	Introduction to Electrical Engineering, Current and Voltage sources, Resistance, In Capacitance. Ohm's law, Kirchhoff's law, Work, Energy and Power, Electric Current, Resist and Potential Difference, Electromagnetism and Electromagnetic Induction, Fara Electromagnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Series and para of R, L, C components. Voltage Divider and Current Divider Rules. Energy Stored in a Capacitan Parallel and in Series, Sinusoidal voltage and current, Introduction to 3-phase systems,	tance, Potential, day's Laws of llel combination acitor, Capacitor
	DC Networks, Network Theorems and Circuit Analysis	(08 Hours)
Kirch Meth Theo	DC Network Terminologies, Voltage, and Current Sources, Series—Parallel Circuits, Kirchhoff's Voltage Law, Solution of Simultaneous Equations Using Cramer's Rule, Maxwell Method, Nodal Voltage Method (Nodal Analysis), Network Theorems, Superposition Theorem, Norton's Theorem, Millman's Theorem, Maximum Power Transfer Theoremsformation, DC Transients- Transient in R–L Circuit, Transient in R–C Circuit.	l's Mesh Current rem, Thevenin's
	AC Fundamentals and Single-phase Circuits	(08 Hours)
	Introduction, Generation of Alternating Voltage in an Elementary, Generator, Concept of Frequency, Cycle, Time Period, Instantaneous, Value, Average Value, and Maximum Value, Sinusoidal and Non-sinusoidal Wave Forms, Concept of Average Value and Root Mean Square (RMS) Value of an Alternating Quantity Analytical Method of Calculation of RMS Value, Average Value, and Form Factor, RMS and Average Values of Half-wave-rectified Alternating Quantity, Concept of Phase and Phase Difference, Single-phase AC	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

m @

Andrew At - Proces

of form of

#### Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Reactive Power, Power in an AC Circuit, R–C Series Circuit, R–L–C Series Circuit, AC Series—Parallel Circuits, Resonance in AC Circuits.  Semiconductor Devices	(09 Hours
Intrinsic and extrinsic semiconductors-, n-Type Semiconductor Material, P-Type Semiconductor Diodes and Extra Property Semiconductor Diodes Parameters and Diode Ratings, Zener Diode, Zener Diode as Vice Reference Voltage, Diode and Triode for Alternating Current (DIAC and TRIAC), Osci Criterion, sinusoidal and non-sinusoidal oscillators, Multivibrators: Astable, Month Multivibrator, Transistors, Bipolar Junction Transistors, Working of a n-p-n and Transistor Configurations, Transistor as an Amplifier, Transistor As a Switch, Field Junction Field Effect Transistors (JEFT), Metal-Oxide-Semiconductor Field-Effect Transistors	niconductor Material racteristic of a Diode oltage Regulator and cillators, Barkhauser ostable and Bistable d p-n-p Transistor d Effect Transistors
Integrated Circuits	(07 Hours)
Introduction to Monolithic and Hybrid ICs, Linear and Digital ICs, Amplifiers, Operation OP-AMP, Application of OP-AMP as a Summing, Differential Amplifier, The 555 Tim Three Operating Modes of IC 555, Pin configuration, Functional Block Diagram, Asta application of IC 555, IC Voltage Regulators or Regulator ICs.	er Integrated Circuit
Principles of Electronic Measurements and Sensors	(06 Hours
Analog and Digital Instruments, Passive and Active Instruments, Static Characteric Accuracy, Precision, Sensitivity and Resolution, Error, Threshold, and Loading Electroments- CRO (Cathode Ray Oscilloscope), Measurement of Power in DC and AC Comments of Power in DC and AC Commen	ffect, Indicating-typ

#### 3. Practicals:

- 1. Measure and confirm Ohm's Law, by measuring measuring voltage and current across a resistor while varying the DC supply voltage in steps, keeping the resistance constant, and plotting the V–I graph to observe the linear relationship.
- 2. Demonstrate Kirchhoff's Current Law (KCL) at a circuit junction and Kirchhoff's Voltage Law (KVL) in a closed loop by measuring currents and voltages in a resistive network and comparing them with theoretical values.
- 3. Set up electrical circuits with resistors, inductors, and capacitors in series and parallel combinations, and to measure and verify their equivalent resistance, inductance, and capacitance using appropriate instruments, confirming the theoretical values through practical experimentation.
- 4. To measure and analyze the power consumption in DC and AC circuits by experimentally determining voltage, current, and power factor, and verifying the results using theoretical calculations.
- 5. To observe the time-domain transient behavior of RL and RC circuits during charging and discharging phases.
- Construct a linear electrical network and determine its Thevenin and Norton equivalent circuits by measuring open-circuit voltage and short-circuit current, and then validate the equivalence experimentally through practical observation and comparison with the original network behavior.
- 7. Investigate the load regulation behavior of a Zener diode by varying the load resistance at a constant input voltage, and measuring the output voltage, load current, and Zener current to determine the diode's voltage regulation capability.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M/ ®

Butwo

my Pry Dasse

How

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

- 8. Examine the operation of a inverting and non-inverting amplifier configuration using an OP-AMP by changing input voltage and resistance values, and plotting the output response to validate the voltage gain relationship.
- 9. Analyze the output characteristics of a BJT in common emitter mode by varying the collector-emitter voltage (V<sub>CE</sub>) for fixed base current (I<sub>B</sub>) values and plotting the collector current (I<sub>C</sub>) versus V<sub>CE</sub>.
- 10. Connect, set up, and operate a Cathode Ray Oscilloscope (CRO) for observing sinusoidal waveforms, and to measure key waveform parameters such as amplitude, frequency, and time period by adjusting control settings and analyzing the displayed signal.

#### 4. Books Recommended:

- 1. Milman, Halkias and Jit, Electronics Devices and Circuits, Tata McGraw-Hill, 2nd Edition
- 2. Sedra and Smith, Microelectronics Circuits, 6th edition, Oxford University Press.
- 3. Boylestad, Robert L., & Nashelsky, Louis Electronic Devices and Circuit Theory 11th Edition, Pearson Education, 2015. ISBN: 9781292060546
- 4. Kothari, D. P., & Nagrath, I. J. Basic Electrical Engineering 4th Edition, McGraw-Hill Education, 2019. ISBN: 9789353162344
- 5. Bhattacharya, S. K., & Chatterjee, S. Basic Electrical and Electronics Engineering, Pearson Education, 1st Edition, 2012. ISBN: 9788131733324

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

FAN

Pran

Door

J

Integrated B.Tech.+M.Tech. I (AI) Semester – II	Scheme	L	Т	Р	Credit
DATA STRUCTURES IA102		3	1	2	05

1.	Course Outcomes (COs):	
	At the end of the course, the students will be able to	
CO1	recognize the need of different data structures and understand its characteristics.	
CO2	apply different data structures for given problems.	
CO3	design and analyse different data structures, sorting and searching techniques.	
CO4	evaluate data structure operations theoretically and experimentally.	
CO5	give solution for complex engineering problems.	

2.	Syllabus		
	INTRODUCTION TO DATA STRUCTURES	(03 Hours)	
************	Review of Concepts: Information and Meaning, Abstract Data Types, Internal Representative Data Structures, Arrays, Strings, Structures, Pointers.	esentation of	
-	LINEAR LISTS	(06 Hours)	
	Sequential and Linked Representations of Linear Lists, Comparison of Insertion, Dele Operations for Sequential and Linked Lists, Doubly Linked Lists, Circular Lists, L Template Library (STL), Applications of Lists.		
	STACKS	(06Hours)	
	Sequential and Linked Implementations, Representative Applications such as Recursio Evaluation Viz., Infix, Prefix and Postfix, Parenthesis Matching, Towers of Hanoi, Wire Circuit, Finding Path in a Maze.		
	QUEUES	(06 Hours)	
Operations of Queues, Circular Queue, Priority Queue, Dequeue, Applications of Queue of Time Sharing Operating Systems, Continuous Network Monitoring System Etc.	Operations of Queues, Circular Queue, Priority Queue, Dequeue, Applications of Queue of Time Sharing Operating Systems, Continuous Network Monitoring System Etc.	es, Simulation	
	SORTING AND SEARCHING	(04 Hours)	
	Sorting Methods, Bubble Sort, Selection Sort, Quick Sort, Radix Sort, Bucket Sort, Dictionaries, Hashing, Analysis of Collision Resolution Techniques, Searching Methods, Linear Search, Binary Search, Character Strings and Different String Operations.		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Par Provent popular

TREES	(08 Hours)			
Binary Trees and Their Properties, Terminology, Sequential and Linked Implementation Methods and Algorithms, Complete Binary Trees, General Trees, AVL Trees, Arithmetic Expression Evaluation, Infix-Prefix-Postfix Notation Conversion, Heaps at Heap Implementation, Insertion and Deletion Operations, Heapsort, Heaps in Tournament Trees, Bin Packing.	Threaded Trees, as Priority Queues,			
MULTIWAY TREES	(05 Hours)			
Issues in Large Dictionaries, M-Way Search Trees, BTrees, Search, Insert and Delete Operations, Height of B-Tree, 2-3 Trees, Sets and Multisets in STL.				
GRAPHS	(07 Hours)			
Definition, Terminology, Directed and Undirected Graphs, Properties, Connections, Adjacency Matrix and Linked Adjacency Chains, Graph Traversal, Bread First Traversal, Spanning Trees, Shortest Path and Transitive Closure, Activity Net Sort and Critical Paths.	th First and Depth			
Tutorials will be based on the coverage of the above topics separately	(15 Hours)			
 Practicals will be based on the coverage of the above topics separately	(30 Hours)			
 (Total Contact Time: 45 Hours + 15 Hours + 30	Hours - 00 Hours			

3.	Tutorials
1	Problems on Array
2	Problems on Stack and Queue
3	Problems on Linked List
4	Problems on Trees
5	Problems on Graph

Practical
Implementation of Array and its applications
Implementation of Stack and its applications
Implementation of Queue and its applications

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVENsemesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Property Property of

4	Implementation of Link List and its applications	
5	Implementation of Trees and its applications	
6	Implementation of Graph and its applications	
7	Implementation of Hashing functions and collision resolution techniques	
8	Mini Project (Implementation using above Data Structure)	

5.	Books Recommended
1	Trembley & Sorenson: "An Introduction to Data Structures with Applications", 2/E, TMH, 1991.
2	Tanenbaum & Augenstein: "Data Structures using C and C++", 2/E, Pearson, 2007.
3	Horowitz and Sahani: "Fundamentals of Data Structures in C", 2/E, Silicon Press, 2007.
4	T. H. Cormen, C. E. Leiserson, R. L. Rivest: "Introduction to Algorithms",3/E, MIT Press, 2009.
5	Robert L. Kruse, C. L. Tondo and Brence Leung: "Data Structures and Program Design in C", 2/E, Pearson Education, 2001.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Proving MP mb

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

				WI
IPG II (AI) Semester-I	L	т	Р	Credit
OBJECT ORIENTED PROGRAMMING	-		10.00	0,00,,,

IA108

1. C	ourse Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Explain the core principles of object-oriented programming using Java and Python: objects, classes, inheritance, polymorphism, and encapsulation.
CO2	Analyse the advantages and limitations of using object-oriented programming compared to procedural programming.
CO3	Design and implement classes in Java to represent real-world entities and their functionalities.
CO4	Apply the concepts of Multithreading and Exception handling to develop efficient and error-free codes.
CO5	Design event-driven GUI and web-related applications that mimic real-world scenarios.

2.	Syllabus	
	Elementary Programming	(06 Hours)
	Introduction Java and Python, Hello World Program, Concepts of object-oriented program Difference between OOP and other conventional programming – advantages and disad Object, Identifiers, Variables, Operators, Data Types, Selections, Loops, Methods, Arrays.	
	Object Oriented Principles and Concepts	(08 Hours)
	Basic concepts of Java and Python programming – advantages of Java and python, byte-coworking and Architecture, garbage collection, Memory Management – Heap/Stack, creation constructor, finalize and, use of method overloading, this keyword, use of objects as parametering objects, call by value & call by reference, static variables & methods, Superclaincluding multilevel hierarchy, process of constructor calling in inheritance, use of super and with super() method, IIB, SIB, dynamic method dispatch, use of abstract classes & method create packages, import packages, and provide member access for packages. Auto Warrowing, Auto up casting, Explicit down casting, Wrapper Classes, AutoBoxing, nested & in	of class, object, eter & methods iss & subclasses d final keywords nods, interfaces. idening, Explicit
	String, Exception, and Text I/O	(07Hours)
	Basic string handling concepts in Java and Python- String, concept of mutable and im StringBuffer, StringBuilder, StringTokenizer, command line arguments, Exception handling	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M) grown (coose)

But

2

Scheme

3

4

#### Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

types of exception classes, use of try & catch with throw, throws & finally, creation	of user-defined
exception classes. Basics of I/O operations – keyboard input using Buffered Reader & :	Scanner classes,
Serialization, Externalization	
Multithreading	(07 Hours)
Basics of multithreading, main thread, thread life cycle, creation of multiple threads, t	nread priorities,
thread synchronization, inter-thread communication, deadlocks for threads, suspendithreads.	ng & resuming
Collections Framework, and Design Patterns	(08Hours)
creation of multiple threads, thread priorities, thread synchronization, inter-thread deadlocks for threads, suspending & resuming threads.  Object class, toString, equals, hashcode, Collection API, Collections, Developing Sta Collections Class, List Stream, Set Stream, TreeSet, MapSteam, Generic Programming, Overview, Factory design pattern, Singleton design pattern, MVC.	ck and Queue,
GUI and Database Programming	(09 Hours)
GUI Basics, Applet Programming, Swing vs AWT, Layout Manager, Event-Driver Program User Interfaces, Menus, Toolbars, Dialogs, JTable, JTree. Introduction JDBC, Type of Driv Statement, Prepared statements, JDBC connection with SQL server.	

#### 3. Practicals:

- 1. Student Management System in Java or Python
- 2. Banking System Simulation in Java or Python
- 3. File Operations with Exception Handling.
- 4. Producer-Consumer Problem with Multithreading
- 5. Employee Management System using Python OOPs concepts
- 6. Observer Pattern for Stock Market using Python OOPs concepts
- 7. Decorator Pattern for Pizza Ordering using Java
- 8. Strategy Pattern for Payment Processing using Python
- 9. Develop a basic student management system to add, delete, update, and view student records. Requirements:
  - Create a form with fields like Student ID, Name, Age, Gender, Department, etc.
  - Provide buttons for Add, Update, Delete, and View.
  - Use a JTable to display the list of students.
  - Use JDBC to connect to a MySQL database and perform CRUD operations.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

MA Soul

Dr. V

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

Implement ActionListener for each button to handle respective actions.

#### 4. Books Recommended:

- 1. Y. Daniel Liang, Introduction to Jave Programming, Comprehensive Version, Person
- 2. Khalid A. Mughal, A Programmer's Guide to Java Scjp Certification: A Comprehensive Primer.
- 3. Dr. R. Nageswara Rao, Core JAVA: An Integrated Approach, Includes All Versions upto Java 8, Dreamtech Press
- 4. Python Programming, Using Problem Solving Approach, Reema Thareja, Oxford university Press
- 5. Herbert Schildt, Java 2 Complete Reference, TMH, 2010.
- 6. Python Object-Oriented Programming Fourth Edition, Steven F. Lott

Doesel Roser.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Integrated B.Tech.+M.Tech. I (AI) Semester II	Scheme	L.	Т	Р	Credit
ENERGY AND ENVIRONMENTAL ENGINEERING		-		_	
EG110		3	0	2	04

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	Explain the components of ecosystems, various biogeochemical cycles and importance of different urban network services
CO2	Differentiate between various types of environmental pollution along with their impacts and regulatory standards
CO3	Examine various global environmental issues and their management
CO4	Discuss the fundamental principles of energy, including classification, conservation and related policy frameworks and regulations.
CO5	Get acquainted with the concept of energy systems and their components

2.	Syllabus	
	ENVIRONMENT AND ECOSYSTEMS	(10 Hours)
	Introduction: Concept of an ecosystem - structure and functions of ecosystem ecosystem - producers, consumers, decomposers; Food chains, food webs, ecological flow in ecosystem; Bio-geochemical cycles, hydrologic cycle Components of environment and their relationship, impact of technology environmental degradation, environmental planning of urban network services such sewerage, solid waste management; closed loop cycle, concepts of sustainability	on environment,
	ENVIRONMENTAL POLLUTION	(10 Hours)
	Water, air, soil, noise, thermal and radioactive, marine pollution - sources, effects control strategies; Centralized and decentralized treatment system, Drinking was standards, ambient air and noise standards	
	GLOBAL ENVIRONMENTAL ISSUES AND ITS MANAGEMENT	(10 Hours)
	Engineering aspects of climate change, concept of carbon credit, CO <sub>2</sub> sequestrate environmental impact assessment and environmental audit, life cycle assessment	ation, concepts of
	BASICS OF ENERGY AND ITS CONSERVATION	
	9	(07 Hours)
-	Classification of energy sources, Global and national energy scenario, Fossil and alte characterization. General aspects of energy conservation and management; Energy	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and Pravior Mily 1/2 EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

TRODUCTION TO ENERGY CONSERVATI	ON SYSTEMS	(08 Hours
ting specifications of various energy o	inciple, Basic components, General fu onversion systems like Power plant, Pu	
nditioner, Internal combustion engine, rbine, Fuel cells.	Solar PV cell, Solar water heating syste	m, Biogas plant. Wind

3.	Practical
1	Performance Test on a computerised single cylinder diesel engine
2	Performance Test on Three-cylinder petrol engine
3	Determination of COP of vapor compression refrigeration system
4	Study of General Motors Cruze Vehicle Automotive System
5	Study of MG Hector Vehicle Automotive Systems
6	Measurement of direct and diffused Solar radiation using pyranometer
7	Determination of I-V Characteristics of solar PV Panel
8	Study of electricity and or gas bill
9	Study of pollutants from diesel Engine
10	Study of pollutants from petrol Engine

4.	Books Recommended
1	Daniel B. Botkin & Edward AKeller, Environmental Sciences, John Wiley & Sons.
2	R. Rajagopalan, Environmental Studies, Oxford University Press.
3	Benny Joseph, Environmental Studies, TMH Publishers.
4	Dr. Suresh K. Dhameja, Environmental Studies, S. K. Kataria & Sons, 2007.
5	U. K. Khare, Basics of Environmental Studies, Tata McGraw Hill, 2011.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

De Proven Minste

#### ADDITIONAL REFERENCE BOOKS

1 C. S. Rao, Environmental Pollution Control Engineering, New Age International Publishers, 2018

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

J Me Jacon My

Y

Integrated B.Tech.+M.Tech. I (AI) Semester – II DISCRETE MATHEMATICS		l.	т	Р	Credit
MA106	Scheme	3	1	0	04

#### 1. Course Outcomes (COs):

At the end of the course, students will be able to

CO1	acquire knowledge of sets, group and functions, graphs.
CO2	apply group theory, relations and lattice.
CO3	analyse functions, counting and based on mathematical logic.
CO4	evaluate formal verification of computer programmes.
CO5	design solutions for various types of problems in different disciplines like information security, optimization, mathematical analysis.

2.	Syllabus	
	Introduction	(04 Hours)
	Introduction to set theory, Basics of functions, Application of Functions in Comput	er Science Areas.
	GROUP THEORY	(08 Hours)
	Basic Properties of Group, Groupoid, Semigroup & Monoid, Abelian Group, Subgroup, Lagrange's Theorem, Cyclic Group, Permutation Group, Homomorphism Groups, Basic Properties, Error Correction & Detection Code.	
	RELATION & LATTICES	(06 Hours)
	Definition & Basic Properties, Graphs Of Relation, Matrices Of Relation, Equivalence Equivalence Classes, Partition, Partial Ordered Relation, Posets, Hasse Diagram, Ul Bound, GLB & LUB Of Sets, Definition & Properties Of Lattice, Sub Lattice, Distributed Lattices, Complemented & Bounded Lattices, Complete Lattices & Boolean Algebra	pper Bounds, Lower tive & Modular
	MATHEMATICAL LOGIC AND PROGRAM VERIFICATION	(06 Hours)
	Induction, Propositions, Combination Of Propositions, Logical Operators & Propos Equivalence, Predicates & Quantifiers, Interaction of Quantifiers with Logical Oper Interference & Proof Techniques, Formal Verification of Computer Programs (Elen Logic).	ators, Logical
	COUNTING AND RECURRENCE RELATION	(06 Hours)
· · · · · · · · · · · · · · · · · · ·	First Counting Principle, Second Counting Principle, Permutation, Circular Permuta Pigeonhole Principle, Recurrence Relations, Linear Recurrence Relations, Inclusion Generating Functions.	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, Prover raffile SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

#### BASICS OF GRAPHS

(05 Hours)

Graph Definition, Graph Representation, Basic Concepts Of Finite & Infinite Graph, Incidence & Degree, Isomorphism, Subgraph, Walk, Path & Circuits, Cliques, Cycles and Loops, Operations On Graphs, Connected Graph, Disconnected Graph & Components, Complete Graph, Regular Graph, Bipartite Graph, Planar Graphs, Weighted Graphs, Directed & Undirected Graphs, Connectivity Of Graphs.

#### **GRAPHS ALGORITHMS**

(10 Hours)

Flows, Combinatorics, Euler's Graph, Hamiltonian Paths & Circuits, Activity Planning and Critical Path, Planar Graphs: Properties, Graph Coloring, Vertex Coloring, Chromatic Polynomials, Edge Coloring, Planar Graph Coloring, Matching and Factorizations: Maximum Matching In Bipartite Graphs, Maximum Matching In General Graphs, Hall's Marriage Theorem, Factorization; Networks: Max-Flow Min-Cut Theorem, Menger's Theorem, Graph and Matrices; Probabilistic Graphical Models: Graphical models, Directed models: Bayesian network, Undirected model: Markov Random Fields, Dynamic model: Hidden Markov Model, Learning in Graphical models: Parameter estimation, Expectation Maximization.

Tutorials will be based on the coverage of the above topics separately

(15 Hours)

(Total Contact Time: 45 Hours + 15 Hours = 60 Hours)

#### 3. Tutorials:

- 1. Problem solving on group theory.
- 2. Problem solving on relation and lattices.
- 3. Problem solving on mathematical logic and program verification.
- 4. Problem solving on counting and recurrence relation.
- 5. Problem solving on basics of graphs.
- 6. Problem solving on graph algorithms.

#### 3. Books Recommended:

- 1. Rosen K.H., "Discrete Mathematics and Its Applications", 6/E, MGH, 2006.
- 2. Liu C.L., "Elements of Discrete Mathematics", MGH, 2000.
- 3. Deo Narsingh., "Graph theory with applications to Engineering & Computer Science", PHI, 2000.
- 4. J. A.Bondy and U. S. R.Murty, "Graph Theory", Springer, 2008.
- 5. V. K. Balakrishnan, "Theory and Problems of Graph Theory", Tata McGraw-Hill, 2007.

#### ADDITIONAL REFERENCE BOOKS

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 -- last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

3) To Sharely Proveds

- 1. Kolman B., Busby R.C. & Ross S., "Discrete Mathematical Structure", 5/E, PHI, 2003.
- 2. Tremblay J. P. & Manohar R., "Discrete Mathematical structure with applications to computer science", MGH, 1999.
- 3. D. B. West, "Introduction to Graph Theory", 2nd Edition, PHI 2002.
- 4. G. Chatrand and O.R. Ollermann, "Applied and Algorithmic Graph Theory", McGraw Hill, 1993.

Subject Code: ##InXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

P

& fr

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG I (AI) Semester – II DIGITAL ELECTRONICS AND LOGIC DESIGN		L	Т	Р	Credit
EC106		3	0	2	04
	Scheme	10000		860	

ourse Outcomes (COs): e end of the course, students will be able to
Simplify Boolean expressions using K-Map and Quine-McCluskey methods for combinational circuit design.
Design combinational and sequential circuits like adders, multiplexers, counters, and registers.
Analyze logic families (RTL, PTL, TTL, CMOS) for efficient digital circuit implementation.
Understand processor architecture and control unit design, including ALU, accumulator, and PLA-based control.
Describe the architecture and organization of a basic processor, control unit design, and explain the structure and types of semiconductor memories.

2.	Syllabus	
	NUMBER SYSTEMS AND BOOLEAN ALGEBRA	(08 Hours)
	Decimal, Binary, Octal, Hexadecimal systems, Number Base conversion, complements of number and its addition and subtraction, Signed binary numbers, Basic definitions, theorem and	mber systems properties of
	Boolean Algebra, Boolean Functions, Canonical and Standard forms, Basic logic operations an	d Digital Logic
	Gates, Karnaugh Map (K-Map) Method, Quine-Mccluskey Tabulation Method, Determination as	
	Selection of Prime Implicants.  COMBINATIONAL LOGIC CIRCUIT DESIGN	(0011 )
	COMBINATIONAL LOGIC CIRCOTT DESIGN	(09 Hours)
	Design Procedure, Adders, Subtractors, Code conversion: Binary to Gray, Gray to Binary, BC and Excess-3 to BCD. Construction using Multi-level NAND and NOR gates. Binary Adder ar Decimal Adder, Magnitude Comparator, Decoders and Encoders, Priority encoder, Demultiplexer, Implementation of Boolean Functions Using Decoder and Multiplexer, BCD Decoder, Hazards in Combinational Circuits.	nd Subtractor, Multiplexers,
	SEQUENTIAL LOGIC CIRCUIT DESIGN	(10 Hours)
	Basic Concepts of Sequential Circuits, Flip-Flops, clocked sequential circuit, State reassignment, Race around condition, Cross Coupled SR Flip-Flop, JK Flip-Flop Rise Condition Toggle Flip-Flops, Truth Tables and Excitation Tables, Master Slave Configuration, Edge and Le Flip-Flops. Basic Concepts and Design of Counters and Registers, Shift Registers, Rip Synchronous counter, Binary Counters, BCD Counters Johnson Counter, Module-N Cousequence, Analysis of Circuit with Latches, Reduction of state and flow tables, Hazards Circuits.	n, D-Type and evel Triggered ople Counter, unter, Timing
	LOGIC FAMILIES	(09 Hours)

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)



AZ R



Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Characteristics of IC digital logic families, Bipolar Transistor Characteristics, Resistor-Transistor Logic (RTL), Pass-Transistor Logic (PTL), and Transistor-Transistor Logic (TTL), along with TTL subfamilies: standard TTL, Schottky Transistor – Transistor Logic (STTL), low-power TTL, Emmitter-Coupled Logic (ECL), Direct Coupled Transistor Logic (DCTL), Integrated Injection Logic (IIL), Diode – Transistor Logic (DTL), High – Threshold Logic (HTL)

#### Memories and Processor Design

(09 Hours)

Basic Processor organization and its architecture, Hardware component: Design of the Arithmetic Logic Unit (ALU), Datapath, Instruction Fetch and Execution, Control unit organization, Control Signals, Hardwired Control Microprogrammed control. Programmable Logic Array (PLA) and Programmable Array Logic (PAL) for efficient control unit design. Introduction to Complementary Metal Oxide Semiconductor (CMOS)-based PLA, CMOS Characteristics and Transmission gate circuit, Semiconductor RAM Memories, Internal Organization of Memory Chips, Memory decoding, Logical construction of RAM, Static Memories, Dynamic RAMs, Read-only Memories (ROM), PROM, EPROM, EPROM, Memory Hierarchy.

(Total Contact Time: 45 Hours + 30 Hours = 75 Hours)

#### 3. Practical:

- 1. Implement and test basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) and their truth tables using digital ICs.
- Design and implement optimized logic circuits by simplifying Boolean functions using Karnaugh Map (K-Map) and Quine-McCluskey methods.
- Design and Implementation of Combinational Circuits Construct and verify the working of adders (Half & Full Adder), subtractors, multiplexers, and decoders using logic gates.
- Design and implement a BCD to 7-segment display driver using combinational logic and verify its working for common anode and common cathode displays.
- 5. Construct and test different flip-flops (SR, JK, D, T, Master-Slave, Edge-Triggered) and analyze their truth tables and timing diagrams.
- Implement and verify binary, BCD, up/down, Johnson, and modulo-N counters using flip-flops and state diagrams.
- 7. Construct and test different types of shift registers (SISO, SIPO, PISO, PIPO) and analyze their operations.
- 8. Design circuits using RTL, PTL, TTL, and CMOS logic families and compare their performance in terms of power consumption, propagation delay, and switching speed.
- 9. Implement a basic ALU using logic gates and multiplexers to perform arithmetic and logic operations.
- 10. To simulate and verify the read and write operations in Static RAM (SRAM) and read operations in ROM using digital design tools.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: O1 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)



MA

Drawen

Y

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

#### 4. Books Recommended:

- 1. Mano, M. M., & Ciletti, M. D. (2018). Digital Design (6th ed.). Pearson Education. ISBN: 978-0134549897.
- 2. R. P. Jain, Modern Digital Electronics, 4th Edition, McGraw Hill, 2009, ISBN: 978-0070669116.
- 3. Ronald J. Tocci, Neal Widmer, Greg Moss, Digital Systems: Principles and Applications, 10th edition, Pearson, 2009.
- 4. John F. Wakerly, Digital Design: Principles and Practices, 4th Edition, Pearson, 2005, ISBN: 978-0131863897.
- 5. Stephen Brown & Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Edition, McGraw Hill, 2008, ISBN: 978-0077221430.
- 6. Donald D. Givone, Digital Principles and Design, 1st Edition, McGraw Hill, 2002, ISBN: 978-0072525038.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

MAS Proun

Y

Integrated B.Tech.+M.Tech. I (AI) Semester – II	Scheme	L.	Т	Р	Credit
INDIAN VALUE SYSTEM AND SOCIAL CONSCIOUSNESS					
HS120		2	0	0	02

1.	Course Outcomes (COs): At the end of the course, the students will be able to
CO1	interpret the important values that need to be cultivated
CO2	analyse the cultures depicted in Ramayana, Mahabharata, Jainism and Buddhism
CO3	review the structure of Indian knowledge system
CO4	discuss the significance of constitution of India
COS	demonstrate social responsibility

2.	Syllabus				
	HUMAN VALUES AND CONSCIOUSNESS	(08 Hours)			
	Human Values Definition and Classification of Values; The Problem of Hierarchy of Values and their Choice; Self-Exploration; 'Basic Human Aspirations; Right understanding, Relationship and Physical Facility; fulfilment of aspirations; Understanding Happiness and Prosperity, Harmony at various levels.  What Is Consciousness?; Can We Build A Conscious Machine?; Levels Of Consciousness; Mind Matter And Beyond; Holistic Lifestyle; Dealing With Anxiety; Connecting Mind To Brain; Minds, Brains, And Programs.				
	INDIAN CULTURE AND HERITAGE	(07 Hours)			
	Culture and its salient features: The Vedic — Upanishadic Culture and society, Human aspirations in those societies; Culture in Ramayana and Mahabharata: The Ideal Man and Woman, Concepts Maitri, Karuna, Seela, Vinaya, Kshama, Santi, Anuraga — as exemplified in the stories and anecdotes of the Epics; The Culture of Jainism: Jaina conception of Soul, Karma and liberation, Buddhism as a Humanistic culture; The four Noble truths of Buddhism; Vedanta and Indian Culture;				
	INDIAN KNOWLEDGE SYSTEM	(08 Hours)			
	Indian knowledge as a unique system, Place of Indian knowledge in mankind's evolution, Relevance of Indian knowledge to present day and future of mankind, Nature of Indian Knowledge; Structure of Indian Knowledge: Types of knowledge (para, apara), The scientific and the unscientific, Instruments for gaining and verifying knowledge, Knowledge traditions: Lineages, Instruments - debate, epistemology and pedagogy, The inverted tree – axiomatic, deductive, empirical knowledge, and evolution of knowledge; Disciplines of Study: A brief outline of the subjects, the major contributions and theories along with timelines where relevant: Mathematics;				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and Soubject, State of Colored State of Colo EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Astronomy; Physical Sciences; Cosmogony; Language studi- studies/righteousness; Statecraft and political philosophy	es; Astrology; Mora
INDIAN CONSTITUTION	(04 hours)
History of Making of the Indian Constitution; Philosophy of the Indian Salient Features; Contours of Constitutional Rights & Duties; Organs of Composition; Qualifications and Disqualifications; Powers and Functions	
SOCIAL RESPONSIBILITY	(03 Hours)
Social Responsibility: Meaning and Importance, Different Approaches	
Social Responsibility of Business towards different Stakeholders. Evoluti in India.	on and registation of CS

3.	Books Recommended
1	D. K. Chaturvedi, Professional Ethics Values and Consciousness, Ane Books Pvt. Ltd., 2023.
2	R.R. Gaur, R Sangal, G. P. Bagaria, Human Values and Professional Ethics, Excel Books, New Delhi, 2010.
3	A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
4	P R Rao, Indian Heritage and Culture, Sterling Publishers Pvt. Ltd, 1988.
5	D. Singh, Indian Heritage and Culture, APH Publishing Corporation, 1998.
6	Sri Prashant Pole, Treasure Trove of Indian knowledge, Prabhat Prakashan, 2021.
7	Sri Suresh Soni, Sources of our cultural heritage, Prabhat Prakashan, 2018.
8	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



Caver, 14 miles

#### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence IPG-Artificial Intelligence

IPG. II (AI) Semester III		l.	Т	Р	Credit
COMPUTER ORGANIZATION					
IA201	Scheme	3	1	0	04

	ourse Outcomes (COs): e end of the course, students will be able to
CO1	acquire knowledge of basics of computer architecture, its components with peripheral devices, instruction set architecture, instruction execution using data path and control unit interface.
CO2	apply knowledge of combinational and sequential logic circuits to mimic simple computer architecture to solve the given problem.
CO3	analyze performance of various instruction set architecture, control unit, memories, various processor architectures.
CO4	evaluate programming solutions to implement fast methods of ALU, FP unit implementations, processor architectures and instruction set architectures.
CO5	implement fast methods of ALU, FP unit implementations and to design and develop hardware solution for given instruction coding scheme of an Instruction Set Architecture or vice versa using available technology tools.

2.	Syllabus				
	PROCESSOR BASICS	(06 Hours)			
	Basics CPU Organization - Functional Units, Data Paths, Registers, Stored Program Concept, Data Representation - Basic Formats, Fixed and Floating Point Representation, Instruction Sets, Instruction Types, Instruction Formats, Addressing Modes, Designing of an Instruction Set, Data path Design, Concepts of Machine Level Programmig, Assembly Level Programming and High Level Programming.				
	ARITHMETIC AND LOGIC UNIT	(08 Hours)			
	Arithmetic and Logical Operation and Hardware Implementation, Implementation of some Complex Operation: Fixed-Point Arithmetic Multiplication Algorithms-Hardware Algorithm, Booth Multiplication Algorithm, Division Algorithm, Divide Overflow Algorithm, Combinational ALU and Sequential ALU, Floating Point Arithmetic Operations.				
	CONTROL UNIT	(07 Hours)			
	Basic Concepts, Instruction Interpretation and Execution, Hardwired Control, Microprogra CPU Control Unit Design, Performance.	mmed Control,			

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

In Roser D Deces MI

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence IPG-Artificial Intelligence

SUBROUTINE MANAGEMENT	( 04 Hours)
Concepts of Subroutine, Subroutine Call and Return.	
MEMORY ORGANIZATION	(06 Hours)
Concepts of Semiconductor Memory, Cpu-Memory Interaction, Organization of Memory and Related Mapping and Replacement Policies, Virtual Memory.	mory Modules, Cache
SYSTEM ORGANIZATION	(06 Hours)
Introduction to InputAnd Output Processing, Working with Video Display Unit and K	
Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfe Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connect	er, DMA Controller,
Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfe Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connect and Memory.	er, DMA Controller,
Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfer Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connect and Memory.  PIPELINE CONTROL AND PARALLEL PROCESSING  Instruction Pipelines, Pipeline Hazards, Pipeline Performance, Superscalar Processin Parallel Processing, Processor-Level Parallelism, Multiprocessor.	er, DMA Controller, ing I/O Devices to CPU (08 Hours)
Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfer Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connect and Memory.  PIPELINE CONTROL AND PARALLEL PROCESSING  Instruction Pipelines, Pipeline Hazards, Pipeline Performance, Superscalar Processin	er, DMA Controller, ing I/O Devices to CPU (08 Hours)

#### 3. Tutorials:

- 1. Problems on data conversion in various formats and floating-point representation
- 2. Solving computations involving complex arithmetic operations and hardware implementation of the same
- 3. Interpretation of basic instruction execution and various addressing modes possible
- 4. Learning instruction set architecture level instructions for the high level language programming
- 5. Problems on memory management, mapping and replacement policies

#### 4. Books Recommended:

- John L. Hannessy, David A. Patterson, "Computer organization and Design", 3/E, Morgan Kaufmaan, reprint -2003.
- 2. Andrew S. Tanenbaum, "Structured Computer Organization", 6/E, PHI EEE, reprint 1995.
- 3. William Stallings, "Computer Organization & Architecture: Designing For Performance", 6/E, PHI, 2002.
- 4. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization", 5/E, McGraw-Hill, 2002.
- 5. Morris Mano, "Computer Systems Architecture", 3/E, PHI, reprint 1997.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

h

M Daces Mt

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence IPG-Artificial Intelligence

IPG. II (AI) Semester – III		L.	Т	Р	Credit
DATABASE MANAGEMENT SYSTEMS				-	
IA203	Scheme	3	0	2.	04

	ourse Outcomes (COs): e end of the course, students will be able to
CO1	understand different database models and query languages to manage the data for given real life application scenario.
CO2	apply the concept of database model, relational tables, normalization to solve different problems.
CO3	analyze the problems for designing the effective solution using procedural and nonprocedural languages and/or index.
CO4	evaluate the solution using transaction management, concurrency management, query performance and optimization, or recovery.
CO5	implement an efficient solution using industry standards for real life problems.

2.	Syllabus				
	INTRODUCTORY CONCEPTS OF DBMS (03 Hours)				
	Introduction, Applications of DBMS, Purpose of Database, Data Independence, Database System Architecture, Data Abstraction, Database users and DBA.				
	ENTITY RELATIONSHIP MODEL (06 Hours)				
	Basic Concepts, Design Process, Constraints, Keys, Design Issues, E-R Diagrams, Attribute Types, Mapping Cardinality, Types of Relationship, Weak/Strong Entity Sets, Extended E-R Features Generalization, Specialization, Aggregation.				
	RELATIONAL MODELS (04 Hours				
	Structure of Relational Databases, Domains, Relations, Mapping of ER Model to Relational Model, Relational Algebra – Fundamentals, Operators and Syntax, Relational Algebra Queries, Tuple Relational Calculus.				
	RELATIONAL DATABASE DESIGN (08 Hours				
	Functional Dependency — Definition, Trivial and Non-trivial FD, Closure of FD Set, Closure of Attributes, Irreducible Set of FD, Normalization — 1Nf, 2NF, 3NF, Decomposition using FD- Dependency				

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

The Same Mf

QUERY PROCESSING AND OPTIMIZATION	(05 Hours)
Overview of Query Processing, Measures of Query Cost, Select Operation, Sorting, Operations, Evaluation of Expressions, Overview of Query Optimization, Transfo Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plan Advanced Topics in Query Optimization.	rmation of Relational,
TRANSACTION MANAGEMENT	(06 Hours)
Transaction Concepts, Properties of Transactions, Serializability of Transactions and Related Problems, Solution to Concurrency Related Problems, Two-phase Locking Protocol, Deac Locking, System Recovery, Recovery and Atomicity, Log-based Recovery.	, Locking Mechanism,
SQL CONCEPT	(05 Hours)
Basics of SQL, DDL,DML,DCL, Structure — Creation/Alteration, Defining Const Foreign Key, Unique, Not Null, Check, IN Operator.	raints Primary Key,
PL-SQL CONCEPT	(04 Hours)
Cursors, Stored Procedures, Stored Function, Database Triggers.	1
ADVANCED TOPICS	(04 Hours)
Data Security: Introduction, Discretionary Access Control, Mandatory Access Consemi Structured Data and XML, Object Oriented and Object Relational DBMS, Dis DBMS.	ntrol, Data Encryption, tributed DBMS, NOSQL
	(30 Hours)
Practicals will be based on the coverage of the above topics separately	

4.	Practicals:
1	Implementation for Physical data storage (Sequential, Index Sequential)
2	Practicing DDL and DML Queries for database creation and managing the data
3	Develop a Database system for the real life application scenario by managing the storage constrains
4	Practicing PL/SQL with the designed databases
5	Design considering Transaction management and concurrency control

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30–lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

l-

Provide Stranger MI

6	Design of ER model based example
7	Design of Relational model based example
8	Design of Normalized form of database

#### 5. Books Recommended:

- 1. A Silberschatz, H. F. Korth, and S Sudarshan, "Database System Concepts", 6/E, TMH, 2010.
- 2. McFadden, F.Hoffer, Prescott: M. B "Modern database management", 8/E, Benjamin/Cummings Inc,2006.
- 3. C.J Date, "An Introduction to Database Systems", Publisher: Addison, Wesley, 8/E, 2003.
- 4. Raghu Ramakrishnan and Gehrke: "Database Management System", 3/E, WCB/McGraw-Hill, 2003.
- 5. Margaret H. Dunham, "Data Mining: Introductory and advanced topics", Pearson Education, 2003.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

fr

Parent accept My

IPG. II (AI) Semester – III DESIGN AND ANALYSIS OF ALGORITHMS		L	Т	P	Credit
IA205	Scheme	3	1	0	04

	ourse Outcomes (COs): e end of course, students will be able to
CO1	Acquire knowledge about the application of mathematical formula and technique to solve the problem and computational complexity analysis.
CO2	Apply the different algorithm design techniques for designing a solution of different applications.
CO3	Analyse the performance of algorithms using different algorithmic design techniques based on asymptotic or amortized or probabilistic methods.
CO4	Evaluate the correctness and implementation of algorithms using different methods of performance evaluation.
CO5	Design and innovate efficient algorithms in the field of computer science & engineering and industry related applications using the different algorithm design techniques.

•	Syllabus	
	INTRODUCTION	(06 Hours)
Introduction to Algorithms, Analysis and Design Techniques, Analysis Techniques: and Asymptotic Analysis. Recurrence Relations and Solving Recurrences, Mathem Amortized Analysis, Probabilistic Analysis.	Introduction to Algorithms, Analysis and Design Techniques, Analysis Techniques: Mather and Asymptotic Analysis. Recurrence Relations and Solving Recurrences, Mathematical P Amortized Analysis, Probabilistic Analysis.	matical, Empirical roof Techniques,
	DIVIDE AND CONQUER APPROACH	(06 Hours)
	Sorting & Order Statistics, Divide and Conquer Technique, Various Comparison based Sor Worst-Case and the Best-Cases, Randomized Sorting Algorithms, Lower Bound on Sorting based Sorts, Medians and Order Statistics, Min-Max Problem, Polynomial Multiplication, Transform.	, Non-comparison
	GREEDY DESIGN TECHNIQUES	(08 Hours)
	GREEDY DESIGN TECHNIQUES  Basic Greedy Control Abstraction, Motivation, Thirsty Baby Problem, Formalization, Activits Variants, Huffman Coding, Horn Formulas, Tape Storage Problem, Container Loading Problem, Graph Algorithms, Graph algorithms: All-pairs Shortest Paths, Topological Order in Directed Graphs, Strongly Connected Components, Minimum Spanning Trees, Single Scapaths, Maximum Bipartite Cover Problem, Network Flows: Ford Fulkerson Algorithm, Matheorem, Polynomial Time Algorithms for Max-flow.	ity Selection and Problem, Knapsack Pring of DAG, DFS Durce Shortest

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

In.

M B

and has

Motivation, Matrix Multiplication Problem, Assembly Line Problem, Coin Changi Common Subsequence, O/1 Knapsack problem, All-pairs Shortest Path Problems Control Abstraction, Optimal Binary Search Tree.	ng Problem, Longest , Dynamic Programming
SEARCHING ALGORITHMS	(05 Hours)
Backtracking,N-Queens Problem, Sum of Subset Problem, Complexity Analysis, Cost Branch & Bound (LCBB), LCBB Complexity Analysis, 15-Puzzle Problem, Trav Problem.	, Branch & Bound, Least veling Sales Person
NUMBER THEORETIC ALGORITHMS	(06 Hours)
Number Theoretic Notions, GCD, Modular Arithmetic, Chinese Remainder Theor Groups, Galois Fields, Applications in Cryptography, Primality Testing.	rem, Generators, Cyclic
NP-COMPLETE PROBLEMS	(06 Hours)
Polynomial Time, Verification, NP-completeness, Search Problems, Reductions, Completeness, Approximation Algorithms, Local Search Heuristics.	Dealing with NP-
Tutorials will be based on the coverage of the above topics.	(15 Hours)
(Total Contact Time: 45 He	ours + 15 Hours = 60 Hours)

## 3. Tutorials: 1. Problem solving on time analysis of sorting algorithms. 2. Problem solving on divide and conquer technique. 3. Problem solving on greedy design technique. 4. Problem solving on dynamic programming. 5. Problem solving on searching algorithms. 6. Problem solving on back tracking technique. 7. Problem solving on Graph based algorithms. 8. Problem solving on branch and bound technique.

#### 4. Books Recommended:

- 1. Cormen, Leiserson, Rivest, Stein," Introduction to Algorithms", 3/E, MIT Press, 2009.
- 2. J. Kleinberg, E. Tardos, "Algorithm Design", 1/E, Pearson Education, Reprint 2006.
- 3. SartajSahni, "Data Structures, Algorithms and Applications in C++", 2/E, Universities Press/Orient Longman,
- 4. Sara Baase, Allen van Gelder," Computer Algorithms: Introduction to Design & Analysis, 3/E, Pearson

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subject of fered in both ODD and EVEN semesters, XX: 01 to 30-last digit ODD and EVEN for ODD and EVEN semesters, XX: 01 to 30-last digit ODD and EVEN for ODD and EVEN semesters, XX: 01 to 30-last digit ODD and EVEN for ODD and EVEN semesters, XX: 01 to 30-last digit ODD and EVEN sembles digit ODD and EVEN semesters, XX: 01 to 30-last digit ODsemesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNITSurat)

CurriculumSVNITSurat(58th Senate, 31May 2023)

In My Davier My

Education, 2000.

5. Knuth, Donald E., "The Art of Computer Programming, Vol I &III", 3/E, Pearson Education, 1997.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

S

Rose MI

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

## Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG II (AI) Semester – III		1		Г	
SIGNALS AND SYSTEMS		L	T	P	Credit
EC203		-			
2000-000-000-000-000-000-000-000-000-00	Scheme	3	1	0	04

#### 1. Course Outcomes (COs):

Attn	e end of the course, student	s will be able to
	D	

CO1	Describe Signals and Systems with their classifications
CO2	Describe Z-transform and its properties
CO3	Analyse discrete-time system with Z-transform
CO4	Understand the process of sampling and aliasing error.
CO5	Analyze Discrete Time Fourier Transform and Discrete Fourier Transform for LTI systems

2.	Syllabus		
	INTRODUCTION	(05 Hour	
	Introduction to Signal and its Classification, Concent of Francis	(05 Hour	
Introduction to Signal and its Classification, Concept of Frequency in Continuous-Ti Signal.	Signal.	Discrete-Time	
	DISCRETE TIME SIGNAL AND SYSTEM		
		(08 Hours	
	Discrete-Time Signals and basic operations, Discrete Time Systems, Linear Time-Inv	ariant System	
	Properties of LTI Systems, Causal LTI Systems Described by Difference equations.	ariant Systems	
	Z-TRANSFORM	100000000000000000000000000000000000000	
		(08 Hours	
	Z-transform, Properties of Region of convergence, Inverse Z-transform, properties of transform for LTI systems with pole-zero patterns	Ztransform. Z	
	SAMPLING		
_	The second of contracts	( 08 Hours	
	Sampling theorem, Periodic Sampling, Frequency-Domain Representation of Sampling, Recor	actruction of	
	sampled signals, Aliasing error, sampling theorem, Sampling of Bandlimited Signals	istruction of	
	DISCRETE TIME FOURIER TRANSFORM (DTFT) and DISCRETE FOURIER TRANSFORM (DFT)		
+		(08 Hours)	
	DTFT and it's convergence, Properties of DTFT, Sampling the Fourier Transform, The D	iscrete Fourier	
Transform, Properties of the Discrete Fourier Transform.		is a country	
	FREQUENCY DOMAIN ANALYSIS OF LINEAR TIME-INVARIANT SYSTEMS	100 11	
		(08 Hours)	
	ions, Frequency Response of LTL Section Systems, Frequency Response for Rational sy		
ranctions, frequency response of LII Systems, System analysis with frequency		epresentation	
-	Time domain and Frequency domain aspects of ideal and non-ideal filters		
	(Total Contact Time: 45 Hours+ 15 Hours)		

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigit0 (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

P JP

de dosa.

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

## Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

#### 4. Books Recommended:

- 1. Barry Van Veen Simon Haykin, "Signals and Systems", 2nd Ed., Wiley, 2007
- 2. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals and Systems Prentice Hall India", 2nd Ed., Pearson, 2009.
- 3. B.P. Lathi, "Principles of Linear Systems and Signals", 2nd Ed., oxford, 22 Jul 2009
- 4. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", 4th Ed., PHI, 2007.
- 5. Robert A. Gable, Richard A. Roberts, "Signals & Linear Systems", 3rd Ed., John Wiley, 1995.

De Marine Sound

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:O1to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

IPG. II (AI) Semester – III AUTOMATA AND FORMAL LANGUAGES		L	Т	Р	Credit
IA211	Scheme	3	1	0	04

	ourse Outcomes (COs):
At the	end of the course, students will be able to
CO1	acquire knowledge of the basis of theory of computation, different computational problems and the importance of automata as a modelling tool of computational problems.
CO2	to apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO3	analyse the solutions for different problems and argue formally about correctness on different restricted machine models of computation.
CO4	evaluate and Identify limitations of computational models and possible methods of proving them.
CO5	design the solution in the forms of different types of machine with correctness proof and able to develop different system software.

2.	<u>Syllabus</u>	
	INTRODUCTION	(06 Hours)
	Basic Mathematical Objects: Sets, Logic, Functions, Relations, String Induction: Inductive Proofs, Principles, Recursive Definitions, Set No	s, Alphabets, Languages; Mathematical tation.
	FINITE AUTOMATA AND REGULAR EXPRESSIONS	(12 Hours)
	Finite State Systems, Deterministic Finite Automata; Nondeterminis Finite Automata with Epsilon, Applications, Kleene' Theorem; Two-v	vay Finite Automata, Finite Automata with
	Output, Regular Languages & Regular Expressions, Properties of Reg Regular Sets, Closure Properties, Decision Properties of Regular Lan Automata, Moore and Mealy Machines.	guages, Equivalence and Minimization of
	Regular Sets, Closure Properties, Decision Properties of Regular Lan	guar Sets: The Pumping Lemma for guages, Equivalence and Minimization of (14 Hours)
	Regular Sets, Closure Properties, Decision Properties of Regular Lan Automata, Moore and Mealy Machines.	(14 Hours)  Tree, Application of CFG, Simplification Hierarchy, Unrestricted Grammars, es, Properties of Context Free Languages:
	Regular Sets, Closure Properties, Decision Properties of Regular Lan Automata, Moore and Mealy Machines.  CONTEXT FREE GRAMMARS  Definition, Derivation Trees & Ambiguity, Inherent Ambiguity, Parse of CFG, Normal Form of CFG, Chomsky Normal Form and Chomsky Context-Sensitive Languages, Relations between Classes of Languages	(14 Hours)  Tree, Application of CFG, Simplification Hierarchy, Unrestricted Grammars, es, Properties of Context Free Languages:

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

l-

KP

Don'

MJ

TURING MACHINES	(O7 Hours)
Turing Machine Model, Language of a Turing Machine (TM), Programming TM, Multiple TM, One-Tape and Multi-Tape TM, Deterministic and Non de Churche Thesis, Recursively Enumerable Languages, Decidability, Reducible Problems NP Hard, NP Complete.	terministic TM, Universal TM,
Tutorials will be based on the coverage of the above topics.	(15 Hours)
Tutorials will be based off the coverage of the above topics.	

3.	Tutorials:
1	Problem statements based on Regular Language and Finite Automata.
2	Questions based on Context Free Grammar.
3	Problems regarding Push Down Automata.
4	Solving Problems for Turing Machine.
5	Decidable and Undecidable Problems.

#### 4. Books Recommended:

- 1. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, 3/E, 2013.
- 2. John C Martin, "Introduction to Languages & the Theory of Computation", 3/E, Tata McGraw-Hill, 2011.
- 3. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction to Automata theory, languages computation, 3/E, Pearson India, 2008.
- 4. Daniel I A Cohen, "Introduction to Computer Theory", John Wiley & Sons, 2/E, Reprint 2008.
- 5. Andrew Ilachinski, "Cellular Automata", 1st Ed., World Scientific, 2001.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

Sr

the Laws

M

IPG. II (AI) Semester – IV		L.	Т	Р	Credit
ARTIFICIAL INTELLIGENCE IA202	Scheme	3	0	2	04

1.	Course Outcomes (COs):
At en	d of the program, students will beable to
CO1	understand the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
CO2	apply various knowledge representation technique, searching techniques, constraint satisfaction problem and example problems- game playing techniques.
CO3	analyse the current scope, potential, limitations, and implications of intelligent systems.
CO4	evaluate the AI techniques suitable for recent areas of applications like expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision.
CO5	design a real world problem for implementation and understand the dynamic behaviour of a system.

2.	Syllabus	
	INTRODUCTION TO AI	(O5 Hours)
	Intelligent Agents, AI Techniques, AI-Problem formulation, AI Applications, Production Strategies.	Systems, Control
	KNOWLEDGE REPRESENTATION	(06 Hours)
	Knowledge Representation Using Predicate Logic, Introduction to Predicate Calculus,	Resolution, Use of
	Predicate Calculus, Knowledge Representation Using other Logic-Structured Represen	itation of Knowledge.
	Predicate Calculus, Knowledge Representation Using other Logic-Structured Representation Using other Logic-Structured Representation Using other Logic-Structured Representation Using other Logic-Structured Representation	itation of Knowledge.
		(06 Hours)

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

A Desert My

Generate and Test, BFS, DFS, Blind, Heuristic, Problem-Reduction, A, A*, AO*, Mi Propagation, Neural, Stochastic, and Evolutionary Search Algorithms, Sample App Performance and Analysis of Search Algorithms, Problem Reduction, Constraint S	olications, Measure or
Analysis, Issues in the Design of Search Programs.	
KNOWLEDGE INFERENCE	(06 Hours
Knowledge Representation -Production Based System, Frame Based System; Infe Chaining, Forward Chaining, Rule Value Approach; Fuzzy Reasoning — Certainty F Bayesian Network-Dempster — Shafer Theory; Symbolic Logic Under Uncertainty: Reasoning, Logics for Non-Monotonic Reasoning; Statistical Reasoning : Probabil Certainty Factors, Probabilistic Graphical Models, Bayesian Networks, Markov Ne	Non-Monotonic ity and Bayes Theorem,
GAME PLAYING AND PLANNING	(06 HOURS
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner	ining, Monthear Planning
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner Deepening The Blocks World, Components of a Planning System, Goal Stack Plan	ining, Montinear Plantining
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner Deepening, The Blocks World, Components of a Planning System, Goal Stack Plan Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Plannin	g Techniques.  (05 Hours
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner Deepening, The Blocks World, Components of a Planning System, Goal Stack Plan Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Plannin NATURAL LANGUAGE PROCESSING	g Techniques.  (05 Hours  Processing, Spell Checking
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner Deepening, The Blocks World, Components of a Planning System, Goal Stack Plan Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Plannin NATURAL LANGUAGE PROCESSING  Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic F	rocessing, Spell Checking.  (05 Hours)  (05 Hours)  (05 Hours)
Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refiner Deepening, The Blocks World, Components of a Planning System, Goal Stack Plan Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Plannin NATURAL LANGUAGE PROCESSING Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic EXPERY SYSTEMS  Expert Systems, Architecture of Expert Systems, Roles of Expert Systems, Knowledge Processing, Semantic Systems, Roles of Expert Syst	rocessing, Spell Checking  (05 Hours)  (05 Hours)  (05 Hours)

3.	Practicals:
1	Practical assignment to understanding basic concepts of prolog.
2	Practical assignment to implement various search strategies.
3	Practical assignment to implement various algorithm based on game theory.
4	Implementation of heuristic based search techniques.
5	Implementation of neural network based application.
6	Implementation of fuzzy logic based application.
7	Implementation of fuzzy inference engine for an application.
8	Implementation of neuro-fuzzy based system.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigit0 (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

fr

M D Lased Mr

#### 4. Books Recommended:

- 1. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.
- 2. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
- 3. Nils Nilsson, Artificial Intelligence: ANew Synthesis, Morgan Kaufmann, 1998,
- 4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2010.
- 5. I. Bratko, "Prolog Programming for Artificial Intelligence", 3/E, Addison-Wesley, 2001, 0-201-40375-7.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

(P)

Locase Mf M

grand 6

IPG. II (AI) Semester – IV OPERATING SYSTEMS		l.	Т	Р	Credit
IA204	Scheme	3	0	2	04

and the same	ourse Outcomes (COs):
At the	end of course, students will be able to
CO1	understand the significance of operating system in computing devices, exemplify the communication between application programs and hardware devices through system calls.
CO2	compare and illustrate various process scheduling algorithms.
CO3	apply appropriate memory and file management schemes.
CO4	illustrate various disk scheduling algorithms.
CO5	design access control and protection based modules for an operating system.

2.	Syllabus		
	OPERATING SYSTEM OVERVIEW	(O4 Flours)	
	Operating System (OS) Objectives, Evolution, Types, Major Achievements, Mo Virtual Machines, OS Design Considerations for Multiprocessor and Multicore	odern Operating Systems,	
	PROCESSES AND THREADS	(O5 Hours)	
	Process Concept, Process States, Process Description, Process Control Block, PCB as a Data Structure in Contemporary Operating Systems, Process Hierarchy, Processes vs Threads, Types of Threads, Multicore and Multithreading, Case Study: Linux & Windows Process and Thread Management and its Related System Calls.		
	CONCURRENCY: MUTUAL EXCLUSION AND SYNCHRONIZATION	(O5 Hours)	
	Principles of Concurrency, Mutual Exclusion, Semaphores, Monitors, Message Problem.	e Passing, Readers/Writers	
	CONCURRENCY: DEADLOCK AND STARVATION	(05 Hours)	
	Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Philosopher's Problem, Case Study: Linux & Windows Concurrency Mechanis		
	SCHEDULING	(08 Hours)	

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:O1to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

h

D Los

MF

N

Scheduling Algorithms: Short Term Scheduling Criteria, Use of Priorities, A Performance Comparison, Fair-Share Scheduling. Multiprocessor Schedul Process Scheduling, Thread Scheduling, Real-Time Scheduling: Characteri Scheduling, Deadline Scheduling, Rate Monotonic Scheduling, Priority Inv. Windows Scheduling.	ling: Granularity, Design Issue, istics of RTOS, Real-Time
MEMORY MANAGEMENT	(05 Hours)
Memory Hierarchy, Static and Dynamic Memory Allocation, Overview of Contiguous and Non-Contiguous Memory Allocation, Concepts of Simple	Swapping, Multiple Partitions, Paging, Simple Segmentation.
VIRTUAL MEMORY	(05 Hours)
Virtual Memory Concepts, Pagingand Segmentation using Virtual Memo Policy, Placement Policy, Replacement Policy, Resident Set Management	ry, Protection and Sharing, Fetch , Cleaning Policy, Load Control,
Case Study: Linux & Windows Memory Management.	
	(04 Hours
I/O MANAGEMENT AND DISK SCHEDULING I/O Device, Organisation of the I/O Function, Operating System Design Is	
I/O MANAGEMENT AND DISK SCHEDULING I/O Device, Organisation of the I/O Function, Operating System Design Is Scheduling, RAID, Disk Cache, Case Study: Linux & Windows I/O.	
Case Study: Linux & Windows Memory Management.  I/O MANAGEMENT AND DISK SCHEDULING  I/O Device, Organisation of the I/O Function, Operating System Design Is Scheduling, RAID, Disk Cache, Case Study: Linux & Windows I/O.  FILE MANAGEMENT  Overview of: Files & File Systems, File Structure, File Management Syste B-tree, File Directories, File Sharing, Record Blocking, Secondary Storage Security, Case Study: Linux & Windows File System.	sue, I/O Buffering, Disk  (04 Hours)  ms, File Organisation and Access,

3.	Practicals:
1	Introduction to Basic and Advance commands of Linux.
2	Introduction to Shell Script and programs based on it.
3	Practical based on different Memory management scheme.
4	Practical based on different Process scheduling algorithm.
5	Practical based on different Disk scheduling algorithm.
6	Process synchronization and deadlock.
7	Practical based on file management system.
8	Practical based on input output device management.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigit0 (subjectofferedinbothODDandEVENsemesters,XX:01to30-lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

la



Proved MJ

#### 5. Books Recommended:

- 1. Silberschatz, Galvin and Gagne, "Operating System Concepts", 10/E, John Wiley & Sons, 2018.
- 2. W. Stallings, "Operating Systems: Internals and Design Principles", 9/E, Pearson Pub., 2017.
- 3. W Richard Stevens, Stephen A Rago, "Advanced Programming in the UNIX Environment"; 3/E, Addison Wesley Professional, 2013.
- 4. Kernighan & Pike, "UNIX programming Environment", 2/E, PHI-EEE, 2001.
- 5. A Tanenbaum, A Woodhull, "Operating Systems Design and Implementation", 3/E, PHI EEE, 2006.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

L-

(P)

Sand MP

IPG. II (AI) Semester - IV		l.	Т	Р	Credit
MACHINE LEARNING					
IA206	Scheme	3	0	2	04

	Course Outcomes (COs): e end of the course, students will be able to
CO1	acquire knowledge of pattern recognition, regression, classification, clustering algorithms and statistics.
CO2	apply different classification, regression, machine learning algorithms and modelling.
CO3	analyze the data patterns and modelling for applying the learning algorithms.
CO4	evaluate the performance of an algorithm and comparison of different learning techniques.
CO5	design solution for real life problems like biometric recognition, natural language processing and its related applications using various tools and techniques of machine learning.

2.	Syllabus				
	INTRODUCTION TO MACHINE LEARNING AND RELATED MATHEMATICS	(08 Hours)			
	Introduction to Machine Learning, Why Machine Learning?, Types, Applications of M/L, PML, Fundamentals- Scalars, vectors, tensors, Equations, matrix, determinant, norms, kern and Eigen vectors, introduction to probability and statistics, stochastic descent				
	DATA SAMPLING, PRE-PROCESSING AND PERFORMANCE EVALUATION	(06 Hours)			
	Data sampling, Data preprocessing, Training, Validation, Testing, Performance Evaluation	)			
	SUPERVISED LEARNING	(08 Hours)			
	Classification and Regression, Linear Regression, Logistic Regression, k-Nearest Neighbors Classifiers, Decision Trees, Support vector machine, Bagging, Boosting, Recommender sys				
	ARTIFICIAL NEURAL NETWORKS	( 05 Hours)			
	Artificial neural network- Neurons, Multilayered networks, Backpropagation model, RBM, Recurrent networks, Applications of Neural Networks				
-	UNSUPERVISED LEARNING AND DIMENSIONALITY REDUCTION TECHNIQUES	(07 Hours)			
	Clustering: k-Means Clustering, Density-based clustering, Agglomerative Clustering, Asso Dimensionality reduction, Principal Component Analysis, Linear Discriminant Analysis	ciation rules,			
	DEEP LEARNING	(05 Hours)			
	Deep Neural Networks, Deep learning models/algorithms: CNN, RNN, Deep belief netwo	rks, Auto-encoders			

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58<sup>th</sup> Senate,31May2023)

l

Proven M.

-	APPLICATIONS	(06 Hours)	
	Signal Processing Application, Biometric Recognition, Face and Speech Recognition, Information Retrieval,		
0000	Natural Language Processing, Robotics and other case studies		
	(Total Contact Time: 45 Hours+	30 Hours = 75 Hours)	

#### 3. Lab:

- 1. Handle missing values, normalize features, and perform exploratory data analysis (EDA) on a given dataset.
- 2. Implement linear regression using gradient descent and evaluate it using Mean Squared Error (MSE).
- 3. Build a logistic regression model for binary classification and evaluate using accuracy, precision, recall, and F1-score.
- 4. Implement the K-NN algorithm from scratch and evaluate it on a classification dataset.
- 5. Build a decision tree classifier from scratch and visualize the tree after training on adataset.
- 6. Implement the K-Means algorithm from scratch and apply it for clustering on a given dataset.
- 7. Implement PCA and reduce a high-dimensional dataset to two components, then visualize the data.
- 8. Train a Random Forest classifier on a dataset and evaluate performance with accuracy and confusion matrix
- 9. Build and train a simple feedforward neural network for classification tasks using a deep learning framework.
- 10. ML project development

#### 4. Books Recommended:

- 1. Tom Mitchell, Machine Learning, McGraw-Hill Science/Engineering/Math
- 2. Ian Goodfellow, Yoshua Bengio, Aaaron Courville, Franchis Bach, Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, 2017
- 3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, Second edition
- 4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st Edition, Springer, 2006.
- 5. Geoff Dougherty, "Pattern Recognition and Classification: An Introduction", 1st Edition, Springer, 2013.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate, 31May2023)

P

Prove MA

IPG. II (AI) Semester – IV COMPUTER NETWORKS			L	Т	Р	Credit
IA208	8	Scheme	3	0	2	04

ourse Outcomes (COs): e end of the course, students will be able to
understand computer network models and services offered at different layers of network protocol stack.
apply knowledge of data communication, data transmission techniques using various transmission media to deliver error free data and communicate with multiple nodes.
analyse various routing methods to identify effective routing protocols.
evaluate network performance by means of transport and flow control protocols, Congestion Control protocols and Quality of services.
create a computer network application using modern network tools and simulation softwares.

	Syllabus	
	INTRODUCTION	(06 Hours)
	Overview of Computer Networks and Data Communication, Computer Networking Pr Standards, Types of Computer Networks, Network Topology, Protocol Hierarchies and Interfaces and Services, Networking Devices, OSI and TCP/IP Reference Models.	
	PHYSICAL LAYER	(06 Hours
	Physical Layer Design Issues, Data Transmission Techniques, Multiplexing, Transmission, Asynchronous Communication, Wireless Transmission, ISDN, ATM, Cellular Radio, Swand Issues.	
	LOGICAL LINK CONTROL LAYER	(06 Hours
LLC Design Issues, Framing, Error and Flow Control, Framing Techniques, Error Control N Control Methods, PPP and HDLC.		ol Methods, Flow
	MEDIUM ACCESS CONTROL LAYER	(06 Hours
MAC Layer Design Issues, Channel Allocation Methods, Multiple Access Protocols - A CSMA/CD Protocols, Collision Free Protocols, Limited Contention Protocols, LAN Arc Standards, Ethernet (CSMA/CD), Token Bus, Token Ring, DQDB, FDDI, Bridges and Re		itectures, IEEE -802

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectofferedinbothODDandEVENsemesters,XX:01to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

In

P & Ross MA

		(07 Hours)
	TRANSPORT LAYER	
	Transport Layer Design Issues, Transport Services, Sockets, Addressing, Connection Es Connection Release, Flow Control and Buffering, Multiplexing, Transport Layer Protoc Transport Protocol (RTP), Stream Control Transmission Protocol (SCTP), Congestion C Recent Developments, Virtualization, Network Functions Virtualization(NFV), Softwar	cols, Real Time Control, QoS and
	APPLICATION LAYER	(07 Hours
1	Client Server Model, Domain Name System (DNS), Hyper Text Transfer Protocol (HTTI MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple I Protocol (SNMP) and Recent Developments.	P), Email: SMTP, Network Management
	Practicals will be based on the coverage of the above topics separately	(30 Hours)

3.	Practicals:
1	Study network configuration commands and computer network setup.
2	Implementation of different Data Link and MAC Layer protocols.
3	Implementation of different Network Layer protocols.
4	Implementation of different Transport and Application Layer protocols.
5	Design and configure a network systems using modern network simulator softwares.
6	Implementation of Secured Socket Layer protocol.
7	Implementation of ICMP based message transmission over network.
8	Implementation of SMTP protocol for mail transfer.

#### 4. Books Recommended:

- 1. William Stalling, "Data and Computer Communication", 10/E, Pearson India, 2017.
- 2. B. Forouzan, "Data Communication and Networking", 5/E, McGraw Hill, 2017.
- 3. Douglas E. Comer, "Internetworking with TCP/IP Volume I", 6/E Pearson India, 2015.
- 4. Andrew S. Tanenbaum, "Computer Network", 5/E, Pearson India, 2013.
- 5. W. Richard Stevens, "TCP/IP Illustrated Volume I", 2/E, Addison Wesley, 2011.

SubjectCode:##nXX;##:DepartmentIdentity,n:Year,XX:SubjectSequencenumberXX:lastdigitO (subjectOfferedinbothODDandEVENsemesters,XX:O1to30—lastdigitODDandEVENforODDandEVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects listfor Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4)EG: Engineering Subject,SC:Science Subject(offeredcombinedlyby departments)(SVNITSurat)

CurriculumSVNITSurat(58th Senate,31May2023)

lm



## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG II (AI) Semester -IV		L	Т	Р	Credit
DATA SCIENCE					
IA212	Scheme	3	0	0	3

304,570	ourse Outcomes (COs): If of the Course student will be able to
CO1	Understand types of data and various data science approaches.
CO2	Apply various data pre-processing and manipulation techniques including various distributed analysis paradigm using hadoop and other tools and perform advance statistical analysis to solve complex and large dataset problems.
CO3	Analyze different large data like text data, stream data, graph data.
CO4	Interpret and evaluate various large datasets by applying Data Mining techniques like clustering, filtering, factorization.
CO5	Design the solution for the real life applications.

2.	Syllabus			
•	INTRODUCTION	(04 Hours)		
Examples, Applications and Results Obtained Using Data Science Techniques, Overview of the Process. Types of Data and Data Representations, Acquire Data, Process and Par Manipulation, Data Cleaning, Exploratory Data Analysis.				
	STATISTICS FOR DATA SCIENCE	(04 Hours)		
	The Dimensionality Problem, Singular Value Decomposition (SVD), Principal Component Descriptive and Inferential statistics, Populations and Samples, Hypothesis testing.	t Analysis (PCA),		
•	PARADIGMS FOR DATA MANIPULATION, LARGE SCALE DATA SET	(08 Hours)		
	Mapreduce (Hadoop), Query Large Data Sets in Near Real Time with Pig and Hiv Traditional Warehouses to Map Reduce, Distributed Databases, Distributed Hash Tables.	NAME OF THE PROPERTY OF THE PR		
	Traditional Warehouses to Map Header, 21st 1881 and 1881			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

MS N

& cores

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Data Flattening, Filtering and Chunking, Feature Scaling, Shingling of Documents, Locality Sensit for Documents, Distance Measures, LSH Families for Other Distance Measures.				
•	MINING DATA STREAM	(06 Hours)		
	Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, N Clustering for Streams.	1oments, Windows,		
•	ADVANCED DATA ANALYSIS	(10 Hours)		
	Link Analysis, Mining of Graph, Frequent Item Sets Analysis, High Dimensional and Hierarchical Clustering, Recommendation Systems, Collaborative filtering. Visualization, Data Summaries, Data Storytelling, ML Model-Checking and Comparison.			
0	CASE STUDIES	(05 Hours)		
	NLP in Customer Service, Energy Consumption analysis, Healthcare diagnostics, fraud detection and other applications.			

#### 3. Books Recommended:

- Cathy O'Neil and Rachel Schutt, Doing Data Science: Straight Talk from the Frontline, 1st Edition O'Reilly Media, 2013, ISBN: 978-1449358655
- 2. Tom White, "Hadoop: The Definitive Guide", 4<sup>th</sup> Edition, O'reilly Media, 2015, ISBN: 9781491901687.
- 3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", 2<sup>nd</sup> Edition, Cambridge University Press, 2014, ISBN: 9781107077232.
- 4. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50" by , 1st Edition, O'reilly publishing house, 2017, ISBN: 9781491952962.
- 5. Joel Grus, J. "Data science from scratch", 1st Edition, O'Reilly Media, 2015, ISBN: 9781491901410.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

(A)

M

la Soci

## Sacdar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

Integrated 8. Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

IPG III (AI) Semester-V DEEP LEARNING		I.	Т	p	Credit
1A301	Scheme	3	0	2	4

	Course Outcomes (COs):
At th	e end of the course, students will be able to
CO1	Identify problems that could be solved using Deep learning.
CO2	Understand major components and key concepts of CNN, RNN, GAN, and Transformers.
CO3	Understand recent advancements in GANs.
CO4	Analyze and apply deep learning models for image and text tasks.
CO5	Design applications of Déep learning in Pytorch and Keras.

2.	Syllabus			
	Introduction to Deep learning	(09 Hours)		
	Motivation and History of Deep Learning, Overview of Applications (e.g., Vision, Speech, NLP), Supervised learning, Unsupervised learning, Reinforcement learning, Artificial Neural Networks (ANNs), Shallow neural network, From fully Connected Layers to Convolutions, Convolutions for images, Padding and Stride, Pooling, Activation Functions: Sigmoid, ReLU, Tanh, Forward and Backpropagation Algorithms, Convolution Neural Networks (LeNet) and floating point operations (FLOP), Gradient Descent, Optimization Algorithms in Deep learning, Weight Initialization and Regularization Techniques, Hyperparameter Tuning (Learning Rate, Batch Size), Overfitting and Underfitting			
	Modern Convolution Neural Networks	(05 Hours)		
	Deep Convolution Neural Networks (AlexNet), Network using Blocks (VGG), Network in Network (NiN), Multi-Branch Networks (GoogLeNet), BatchNormalization, Layer Normalization, Instance Normalization, Group Normalization, Residual Networks (ResNet), Densely Connected Network (DenseNet), Transfer Learning and Fine-Tuning, Applications: Image Classification, Object Detection.			
	Modern Recurrent Neural Networks	(08 Hours)		
	Working with sequences, Converting Raw Text into Sequence Data, Basic of Language models, R Neural Networks, Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Deep Recurre Networks, Bidirectional Recurrent Neural Networks, Applications: Text Generation, Sentiment A			
Introduction to Generative Modeling		(08 Hours)		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 -- last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M

MI Pron

Lass

### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

Generative modeling, Auto-encoder, Variational Auto encoders (VAE), Generative Adversarial Networks (GANs), GAN Training and loss function, GAN Challenges, Mode Collapse, Variants of GANs (DCGAN, cGAN, WGAP,WGAN-GP), Applications: Image Synthesis, Style Transfer	
Applications of GANs and Advanced Topics	(06 Hours)
Image-to-Image Translation (pix2pix), Neural Style Transfer (Style GAN), Face Superresolution, Inpainting, Image Segmentation, future of Generative Mode	
Introduction to Transformers and its Applications	(09 Hours)
Attention Mechanisms, Natural Language, Transformer Language Models, Section Transformers, Vision Transformers. Text classification, Question Answering, Tofuture of Transformers, Applications: Machine Translation, BERT, GPT	
(Total Contact Time: 45	5 Hours +30 Hours = 75 Hours )

#### 3. Practicals:

- 1. Basic Programming on deep learning frameworks Pytorch/Keras deep learning frameworks
- 2. Image classification using difference CNN architecture in Pytorch/Keras.
- 3. Transfer Learning of pretrained models on MNIST dataset.
- 4. Time-Series Forecasting with the LSTM Model in Pytorch/Keras.
- 5. Deep learning Techniques for image segmentation in Pytorch/Keras.
- 6. Autoencoders using MNIST Handwritten digits in Pytorch/Keras.
- 7. GAN for generating synthetic image on MNIST Handwritten digits dataset.
- 8. DCGAN for generating synthetic image on CIFAR dataset.
- 9. Text classification using Transformer and Fine-tune a pre-trained Transformer (e.g., BERT) for sentiment
- 10. Minor Project on classification and synthetic image generation and Deploy a trained DL model as a REST API using Flask.

#### 4. Books Recommended:

- 1. Dive into Deep Learning: Book by Aston Zhang, Zack C. Lipton, Mu Li, Alex J. Smola.
- 2. Deep Learning. Book by Ian Goodfellow and Yoshua Bengio and Aaron Courville, The MIT
- 3. Deep Learning Foundations and Concepts, Book by, Christopher M. Bishop, Hugh Bishop

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Joe Josep Mr MJ bron

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

- 4. Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition, 2017.
- 5. Seth Weidman, Deep Learning from Scratch: Building with Python from First Principles, O'Reilly

for 2 accel.

Ar Prom

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 — last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG III (AI) Semester V CLOUD COMPUTING		L.	т	Р	Credit
IA303	Scheme	3	0	2	04

-	Course Outcomes (COs): e end of the course, students will be able to
CO1	Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
CO2	Apply the fundamental concepts in datacenters to understand the tradeoffs in power, efficiency and cost.
CO3	Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.
CO4	Analyze various cloud programming models and apply them to solve problems on the cloud.
CO5	Will understand cloud security concepts, identify risks, and apply security measures to protect cloud environments.

2.	Syllabus				
	OVERVIEW OF COMPUTING PARADIGM AND INTRODUCTION TO CLOUD COMPUTING	(06 Hours)			
	Recent trends in computing, evolution of cloud computing, Cloud computing (NIST model), properties, characteristics and disadvantages, role of open standards.				
	CLOUD COMPUTING ARCHITECTURE	(05 Hours)			
	Cloud computing stack, Service models (XAAS), Deployment models.				
	INFRASTRUCTURE AS A SERVICE	(05 Hours)			
	Introduction, Hypervisors, Resource virtualization, examples.				
	PLATFORM AND SOFTWARE AS A SERVICE	(08 Hours)			
	Introduction, Cloud Platform and Management, Web services, Web 2.0, Web OS examples.				
	SERVICE MANAGEMENT IN CLOUD COMPUTING	(06 Hours)			
Service Level Agreements (SLAs), Billing & Accounting, comparing scaling hardware, managing data.		ics of scaling,			
	CLOUD SECURITY	(07 Hours)			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30—last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

@ m

At Pour

Dogod

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Infrastructure security, Data security and storage, Identity and Access Management, Access Control, and Reputation, Authentication in Cloud computing.	
CASE STUDY ON OPEN SOURCE AND COMMERCIAL CLOUDS	(08 Hours)
Eucalyptus, VMware Cloud and Other case studies	
Practicals will be based on the coverage of the above topics separately	(30 Hours)
(Total Contact Time: 45 H	ours + 30 Hours = 75 Hours)

3. Practicals:	
1. Evaluation of Platform as a Service	
2. Development and Deployment of Software as a Service	
3. Exploration of Service Management in Cloud Computing	
4. Study of Cloud Backup and Disaster Recovery	
5. Analysis of Cloud Cost Optimization	
6. Implementation of Infrastructure and Data Protection	
7. Configuration of identity, Access Control and Authentication in Cloud Computing	41
8. Installation and management of Eucalyptus Cloud	
9. Configuration and deployment of VMware Cloud	

#### 4. Books Recommended:

- 1. Barrie Sosinsky: "Cloud Computing Bible", Wiley-India, 2010
- 2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms", Wiley, 2011
- 3. Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", Springer, 2012
- Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
- 5. Tim Mather, Subra Kumara swamy, Shahed Latif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media, 2009.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 — last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

D W My Proc.

Laure

#### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

## Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG III (AI) Semester V LINEAR AND NONLINEAR OPTIMIZATION	B. Errode (B. 19) (Balleton and American and	L	т	Р	Credit
IA307	Scheme	3	1	0	04

1. (	Course Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Formulate and Solve Linear Programming Problems.
CO2	Apply Techniques for Unconstrained Nonlinear Optimization.
CO3	Solve Constrained Nonlinear Optimization Problems.
CO4	Implement and Utilize Optimization using standard Software Packages.
CO5	Analyze and Model Real-World Optimization Problems.

2.	Syllabus				
	Introduction	(04 Hours)			
	Sets, functions, sequences, continuity, differentiability, gradients, Taylor series expansion. Vec norms, symmetric matrices, eigenvalue decomposition, positive semidefinite and positive def				
	Linear Optimization	(07 Hours)			
	Linear programming, linear algebra, geometry of polyhedra, the simplex method, dualit algorithms, opt: applications to integer linear programs	y, primal dual			
	Convex sets and functions	(06 Hours)			
	Convex sets, examples and properties, Convex functions, strict and strong convexity, examples, and convexity preserving operations, Equivalent definitions of convexity under differentiability assumptions				
	Unconstrained Optimization (0				
	Maxima, minima, stationary point, saddle point, local and global maximum/minimum, F second order conditions for optimality, Linear, quadratic and convex optimization proble				
	Benefits of convexity				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M

**P** 

\/~ >

grand &

#### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

### Department of Artificial Intelligence

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

optimization, Duality for convex optimization theorem of alternative Algorithms for Optimization	(07 Hours)
Gradient descent with fixed step size, line search and Armijo-Golds Conjugate gradient and Quasi-newton methods, Algorithms gradient descent, dual ascent, alternating direction method of mul	for constrained optimization: Projected
Applications	(05 Hours)
Applications  Applications in statistics, machine learning and computer science	(05 Hours)
# 18-18-2	

3. Tutorials:	THE PARTY CAN ALL REAL PROPERTY CHARGE THE PARTY CHARGE THE PARTY.
1. Introduction to Linear Programming & Graphical Method	and desire interconfidences to the facility stay that interest account of the first of stay of
2. Simplex Method (Maximization)	
3. Simplex Method (Minimization) & Special Cases	
4. Duality and Sensitivity Analysis	and the self-self-self-self-self-self-self-self-
5. Introduction to Unconstrained Nonlinear Optimization	######################################
6. Calculating gradients and Hessians, applying steepest descent	MIT 100 / 200 M TO 100 M TO 10
7. Newton's Method & Conjugate Gradient Methods	THE RESERVE OF SURE STATES AND ASSESSMENT OF STATES
8. Constrained Optimization: Lagrange Multipliers	AND A STATE OF THE PARTY OF THE
9. Karush-Kuhn-Tucker (KKT) Conditions	
10. Real-World Applications & Case Studies	

#### 4. Books Recommended:

- 1. Convex optimization by Boyd, Stephen, and Lieven Vandenberghe
- 2. Linear and nonlinear programming by Luenberger, David G., and Yinyu Ye
- 3. Nonlinear programming by Bertsekas, Dimitri P.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Stored Prom

#### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

4. Numerical optimization by Nocedal, Jorge and Wright, Stephen. . Springer, 1999

5. Linear and Nonlinear Optimization by Igor Griva, Stephen G. Nash, and Ariela Sofer

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Locard Dr. M.

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

## Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG. III (AI) Semester – V INFORMATION SECURITY AND CRYPTOGRAPHY		L	Т	Р	Credit
IA309	Scheme	3	1	0	04

-	1. <u>Course Outcomes (COs):</u> At the end of the course, students will be able to			
CO1	understands the key concept and mathematical background of cryptography.			
CO2	apply the concept of security mechanisms from the application developer's perspective.			
CO3	analyse security mechanisms while trying to satisfy the required security services.			
CO4	evaluate different information hiding and authentication techniques.			
CO5	design and develop the security solution depending on the organisation's requirements.			

2.	Syllabus				
	Introduction to Information Security and Cryptography	(03 Hours)			
	Elements of Information Security, Security Attacks, Security Services, Basic Cryptography, Types, Goals of cryptography	erminology in			
	Data Encryption Techniques	(08 Hours)			
	Encryption methods, substitution ciphers: The caesar cipher, mono alphabetic cipher, hill cipher, one-time pad cipher, transposition cipher, Shift Cipher, Permutation Cipher, Stream Ciphers, Cryptanalysis				
	Data Encryption and Advanced Encryption Standards	(09 Hours)			
	Block ciphers, festal cipher, data encryption standard, working and cracking of DES, Concept of advanced encryption standard, Key generation, encryption and decryption procession of AES, advantages of AES.				

Locuel

0

M

Burn

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Number Theory	(06 Hours)
Prime number, Modular arithmetic, Fermat's theorem, Euler	's theorem, Chinese remainder theorem
Symmetric Ciphers	(06 Hours)
Concept of Symmetric cipher, blowfish encryption, RC5, RC4,	IDEA
Public Key cryptosyatem	(06 Hours)
Public key cryptography, key length and encryption strength, algorithm	applications of public key cryptography, RSA
Key management and Authentication	(07 Hours)
Diffie-Hellman key exchange, authentication methods, messa X.509, digital signature	ge digest MD2, MD4 , MD5 , SHA, kerberos,
Practicals will be based on the coverage of the above topics	separately. (30 Hours)
	ntact Time: 45 Hours + 15 Hours = 60 Hours)

#### 3. Tutorials

- 1. Tutorial on Caesar Cipher and Shift
- 2. Tutorial on Monoalphabetic and Playfair Cipher using substitution and digraph-based encryption methods.
- 3. Tutorial on Hill and Affine Cipher using matrix and mathematical transformation techniques.
- 4. Tutorial on number theory
- 5. Tutorial based on Shift Cipher that shifts characters by a fixed number for encryption and decryption.
- 6. Tutorial on DES and AES Algorithms Demonstrate symmetric encryption and compare performance using ECB/CBC modes.
- 7. Tutorial on Diffie-Hellman Key Exchange Simulate secure key sharing over an insecure channel.
- 8. Tutorial on MD5 and SHA Algorithms







M lu

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

#### 4. Books Recommended:

- 1. Stinson, Douglas R., "Cryptography: theory and practice", 3rd Edition, Chapman and Hall/CRC, 2005.
- 2. Stallings, William, "Cryptography and network security: principles and practice", 7th Edition, Upper Saddle River: Pearson, 2017.
- 3. Forouzan, Behrouz A., "Cryptography & network security", 3rd Edition, McGraw-Hill, Inc., 2007.
- 4. Schneier, Bruce, "Applied cryptography: protocols, algorithms, and source code in C", 2nd Edition, john wiley & sons, 2007.

lacu.

Draw

4

B. Tech. III (AI) Semester – V		L	т	р	Credit
GAME THEORY		ļ			
AI351	Scheme	3	1	0	04

_	Course Outcomes (COs): e end of the course, students will be able to
CO1	Learn how individuals and organizations make rational choices in competitive and cooperative environments
CO2	Explore different types of games, including zero-sum, non-zero-sum, cooperative, and non-cooperative games
CO3	Study equilibrium concepts to predict and explain strategic interactions in various scenarios.
CO4	Apply game-theoretic principles to economics, business, politics, social sciences and technology
CO5	Enhance analytical abilities to model and solve strategic problems effectively

2.	Syllabus				
	INTRODUCTION TO GAME THEORY	(06 Hours)			
	Definition, scope, applications, types of games (cooperative vs. non-cooperative, zero-sum vs. non-zero-sum), basic terminology, strategic interactions in economics and social sciences.				
	STRATEGIC FORM GAMES AND NASH EQUILIBRIUM	(08 Hours)			
	Normal-form representation, dominant and dominated strategies, best response analysis, Nash equilibrium, mixed strategies, existence and computation of equilibria.				
	EXTENSIVE FORM GAMES AND SUBGAME PERFECTION	(07 Hours)			
	Sequential games, extensive-form representation, backward induction, subgame perfect equilibrium, perfect information vs. imperfect information games, applications in bargaining				
	REPEATED AND STOCHASTIC GAMES	( 06 Hours)			
	Infinitely repeated games, folk theorems, strategies for cooperation, stochastic games, Markov strategies, applications in long-term strategic interactions.				
No.	BAYESIAN GAMES AND INCOMPLETE INFORMATION	(06 Hours)			
	Games with asymmetric information, Bayesian Nash equilibrium, signaling and screening, auction theory, mechanism design, applications.				
	COOPERATIVE GAME THEORY AND BARGAINING SOLUTIONS	(06 Hours)			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)



N

Jr

M

Soesel &

Core, Shapley value, bargaining games (Nash and Rubinstein models), coalition business and international negotiations.	on formation, applications in	
APPLICATIONS AND ADVANCED TOPICS	(06 Hours)	
Evolutionary game theory, mechanism design, matching markets, voting and fair division, real-world applications in economics, politics, and Al-driven strategy models.		
(Total Contact Time:	45 Hours+ 15 Hours = 60 Hours)	

#### 3. Tutorials:

- 1. Identify and eliminate dominated strategies in normal-form games.
- 2. Compute pure and mixed strategy Nash equilibria using best response analysis.
- 3. Solve sequential games by applying backward induction.
- 4. Analyze long-term strategic interactions and cooperation in infinitely repeated games.
- 5. Solve games where players have private information.
- 6. Study different auction formats and optimal bidding strategies.
- 7. Analyze how coalitions form and distribute payoffs in cooperative games.
- 8. Explore strategic negotiation models and their real-world applications.
- 9. Understand evolutionarily stable strategies (ESS) in dynamic games.
- 10. Apply game-theoretic concepts to business, politics, and cybersecurity.

#### 4. Books Recommended:

- Y. Narahari, "Game Theory and Mechanism Design: 4 (IISc Lecture Notes Series)," World Scientific Publishing Co Pvt Ltd, May 07, 2014, ISBN-13: 978-9814525046
- 2. Anna R. Karlin and Yuval Peres, "Game Theory, Alive," American Mathematical Society, Apr 27, 2017, ISBN-13: 978-1470419820 [Available Online].
- 3. Roger B. Myerson, "Game Theory: Analysis of Conflict," Harvard University Press, September 1997, ISBN-13: 978-0674341159.
- 4. Martin J. Osborne, "An Introduction to Game Theory," Oxford University Press, 2003, ISBN-13: 978-0195128956.
- D. Fudenberg and J. Tirole, "Game Theory," Indian Edition by Ane Books, 2005, ISBN-13: 978-8180520822.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 -- last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)



W/

by M

grand &

## Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence

#### Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG III (AI) Semester – V INTRODUCTION TO QUANTUM COMPUTING		L	Т	Р	Credit
IA353	Scheme	3	0	0	03

5000	Course Outcomes (COs): ne end of the course, students will be able to	
CO1		
CO2	Analyzing Quantum Computing Applications	
CO3	Develop Quantum Circuits Using Qiskit	
CO4	Explore NISQ Era and Industrial Applications	
CO5	Applying Quantum Circuit Models to solve problems	

2.	Syllabus				
	Foundations	(08 Hours)			
	Hilbert spaces (finite dimensional). Axioms of quantum probability. Quantum vs Classical probability.				
	IBM Quantum Perspective, Q Mission in India	(08 Hours)			
	IBM Quantum Composer and Quantum Lab using Qiskit, Quantum Computing Applications, Quantum Computing Basics,				
	Quantum Computing	(11 Hours)			
	Turing machines, Boolean circuits, Quantum Circuits, Universality. Simon's problem, Phase finding, Shor's algorithm, Grovers algorithm, Probability amplification. Some applications.				
	Quantum Information processing	(06 Hours)			
-	Quantum error correction.Knill-Laflamme theorem, Stabiliser codes				
	Quantum Algorithms	(07 Hours)			
	Oracles, Deustch Jozsa, Grover's Algorithm with Hands-on, etc.				
	Quantum Algorithms for NISQ	(05 Hours)			
	NISQ era Quantum Algorithms for VQE/QAOA and industrial applications				
	Tutorials will be based on the coverage of the above topics separately	(15 Hours)			
	Total Contact Time = 45 Hours				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

MD

fram In M

Raen

# Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

#### 4. Books Recommended:

- 1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press (2010)
- 2. Eleanor G. Rieffel, Wolfgang H. Polak, Quantum Computing: A Gentle Introduction (Scientific and Engineering Computation), MIT Press (2014)
- 3. Hiu Yung Wong, Introduction to Quantum Computing: From a Layperson to a Programmer, Springer Nature
- 4. Qiskit Textbook: https://qiskit.org/textbook/preface.html

m D & My Rear Source

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

IPG III (AI) Semester – V NATURAL LANGUAGE PROCESSING		L	Т	Р	Credit
IA355	Scheme	3	0	0	03

At the	Course Outcomes (COs): e end of the course, students will be able to
CO1	Understand the fundamental concepts of NLP and its applications.
CO2	Understand and Implement text preprocessing techniques (tokenization, stemming, lemmatization, etc.).
CO3	Apply various feature engineering, word embeddings, and other deep learning methods for NLP
	tasks.
CO4	The state of the s
CO4	tasks.  Build and evaluate NLP models for text classification, information extraction, and sequence to

2.	Syllabus			
	Introduction to NLP	(05 Hours)		
	What is NLP? History and applications of NLP, Challenges in NLP, NLP pipeline, processing: Regular expressions, finite state automata and its applications	Basic language		
	Text Preprocessing	(07 Hours)		
	Tokenization, stemming, and lemmatization, Stop word removal, Handling nois Language Model, Smoothing Techniques	y text, n-gram		
	Representations for NLP	(08 Hours)		
	Bag of Words (BoW), TF-IDF, N-grams, Word embeddings: Word2Vec, Glo Contextualized word embeddings: BERT, RoBERTa, Unsupervised Word Embeddin			
	Text Classification	( 08 Hours)		
	ML Approaches (Naive Bayes, Support Vector Machines (SVMs), Logistic Regret Trees and Random Forests, Multi-Layer Perceptron), Deep Learning approaches usembeddings, different text classification tasks, Evaluation metrics: Accuracy, precis	sing contextual		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

De la Mit Pron 40

score.	
Sequence Labeling Tasks	(08 Hours)
Part-of-Speech (POS) tagging, Chunking, Constituency and Dependency Parsing	g, Named Entity
Recognition (NER), Relation extraction, Shallow Parsing, Multi-Task Learning, Ev	aluation metrics
for sequence prediction tasks	
Sequence-to-Sequence Modeling	(09 Hours)
Recurrent Neural Networks (RNNs), LSTMs, GRUs, Encoder-decoder archite mechanisms, Beam search, transformers, encoder-only and decoder-only mode Machine translation, Text summarization, Question and Answering, Evaluation r MT, Summarization, and Q&A	ls, Applications
(Total Contact T	ime: 45 Hours)

#### 3. Books Recommended:

- 1. Speech and Language Processing, Daniel Jurafsky and James H. Martin
- 2. Natural Language Processing with Transformers, Lewis Tunstall, Leandro von Werra, Thomas Wolf
- 3. Natural Language Processing with Python by Bird, Klein, and Loper
- 4. Natural Language Processing, Pushpak Bhattacharyya, Aditya Joshi
- 5. Practical Natural Language Processing, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, O'Reilly Media, Inc.
- 6. Online Tutorials: Hugging Face, PyTorch, Sklearn, Stanza, NLTK, Spacy
- 7. Latest research papers from top tier conferences (ACL, NEURIPS, AAAI, NAACL, COLING, CONLL, SIGIR, IJCNLP, LREC)

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

I My grown & special

IPG III (AI) Semester – V APPLIED MACHINE LEARNING		L	Т	Р	Credit
IA357	Scheme	3	0	0	03

_	Course Outcomes (COs): e end of the course, students will be able to
CO1	To understand various machine learning techniques and formulation of problem in diverse field.
CO2	To perform data analysis, data clustering and data transformation techniquesfor better usage and enhancement of available data.
CO3	To evaluate and compare the appropriateness and complexity of various machine learning techniques for real life problems
CO4	To apply these techniques of the algorithms to the hard machine learning problems.
CO5	To design the solution for the real life problems using machine learning approaches.

2.	Syllabus					
	FOUNDATIONS OF APPLIED ML	(06 Hours)				
	Supervised vs Unsupervised Learning, Bias-Variance Tradeoff, Performance Metrics & Mode					
	Feature Engineering & Selection, Data Preprocessing & Augmentation, Handling Imbalanced					
	Hyperparameter Tuning & Optimization, Cross-validation Techniques, Model Interpretability	/				
	DEEP LEARNING AND NEURAL NETWORKS	(07 Hours)				
	Neural Network Architectures, Activation Functions & Loss Functions, Backpropagation & Optimization					
	CNNs for Image Processing, RNNs & LSTMs for Sequence Data, Transformers & Attention M	echanisms				
	Pretrained Models & Transfer Learning, Fine-Tuning Strategies, Autoencoders & GANs					
	ADVANCED SUPERVISED LEARNING	(06 Hours)				
	Ensemble Methods (Bagging, Boosting, Stacking), Gradient Boosting & XGBoost, Explainable AI (XAI)					
	Handling Large-scale Datasets, Distributed Training, Model Deployment in Production Time	Series				
	Forecasting, Sequential Models, Causal Inference in ML					
	UNSUPERVISED AND SELF-SUPERVISED LEARNING	(06 Hours)				
	Clustering Techniques (K-Means, DBSCAN, Hierarchical), Anomaly Detection, Density Estimation					
	Dimensionality Reduction (PCA, t-SNE, UMAP), Representation Learning, Self-Supervised Learning Graph					
	Neural Networks, Network Embeddings, Knowledge Graphs in ML					

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M

for My Prospect

	REINFORCEMENT LEARNING AND OPTIMIZATION	(06 Hours)
-	Markov Decision Processes, Policy Gradients, Q-learning & Deep Q-Networks (DQN) Multi-A	gent RL, Model-
	Based RL, Reward Engineering & Exploration Strategies Bayesian Optimization, Evolutionary	Algorithms,
	Meta-Learning & Few-shot Learning	
	ML IN REAL WORLD APPLICATIONS	(07 Hours)
	ML for Healthcare, Finance & Cybersecurity, Bias & Fairness in AI, Ethical AI & Regulations N for ML, Scalable Model Serving, Cloud & Edge AI Deployment A/B Testing, Experimentation ML-driven Business Intelligence	
	ADVANCED TOPICS AND FUTURE TRENDS	(07 Hours)
	Federated Learning & Privacy-Preserving ML, Differential Privacy, Secure & Trustworthy Al C	Quantum ML,
	Neuromorphic Computing, ML for Scientific Discovery & Autonomous Systems Large Langua	ige Models
	(LLMs), Multimodal AI, Open Challenges in AI Research	
	(Total Contact	Time: 45 Hours)

#### 4. Books Recommended:

- 1. Peter Flach, Machine Learning: The Art and Science of Algorithms That Make Sense of Data, Cambridge University Press, 2012.
- 2. Ian Goodfellow, Yoshua Bengio, Aaaron Courville, Franchis Bach, Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, 2017
- 3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, Second edition
- 4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 1st Edition, Springer, 2006.
- 5. Geoff Dougherty, "Pattern Recognition and Classification: An Introduction", 1st Edition, Springer, 2013.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In At gour Lacous

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG III (AI) Semester ~ VI HIGH PERFORMANCE COMPUTING	Additional and the second	L	Т	P	Credit
IA302	Scheme	3	0	2	04

	Course Outcomes (COs): e end of the course, students will be able to
CO1	Learn concepts, issues and limitations related to parallel computing architecture and software development.
CO2	Apply different parallel models of computation, parallel architectures, interconnections and various memory organization in modern high performance architectures.
CO3	Analyze the algorithms to map them onto parallel architectures for parallelism.
CO4	Evaluate the performance of different architectures and parallel algorithms with different aspects of real time problems.
CO5	Design parallel programs for shared-memory architectures and distributed-memory architectures using modern tools like OpenMP and MPI, respectively for given problems.

2.	Syllabus		
	PARALLEL PROCESSING CONCEPTS	(08 Hours)	
	Levels of Parallelism (Instruction, Transaction, Task, Thread, Memory, Function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc.), Architectures: N wide Superscalar Architectures, Multi-core, Multi-threaded.		
	FUNDAMENTAL DESIGN ISSUES IN PARALLEL COMPUTING	(06 Hours)	
	Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Map Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms.	Napping Parallel	
FUNDAMENTAL LIMITATIONS FACING PARALLEL COMPUTING		(06 Hours)	
	Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and the Power-Aware Computing and Communication, Power-Aware Processing Techniques, Power-Aware Interconnect Design, Software Power Management	heir Limitations, wer-Aware Memory (11 Hours)	
	PARALLEL PROGRAMMING		
Programming Languages and Programming-Language Extensions for HPC, Inter-Process Com Synchronization, Mutual Exclusion, Basics of Parallel Architecture, Parallel Programming Par Programming with OpenMP and (Posix) Threads, Message Passing with MPI.		Communica <b>ti</b> on, Parallel	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30—last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M D la MS

Por Spaced

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

PARALLEL PROGRAMMING WITH CUDA	(10 Hours)
Processor Architecture, Interconnect, Communication, Memory Organization, and High Performance Computing Architectures: (Examples: IBM CEU. BE, Nvidia Tesla Micro architecture and Intel Nehalem Micro architecture), Memory Hierarchy and Memory Design, Thread Organization.	GPU, Intel Larrabee
ADVANCED TOPICS	(04 Hours)
Petascale Computing, Optics in Parallel Computing, Quantum Computers.	
Practicals will be based on the coverage of the above topics separately	(30 Hours)
(Total Contact Time: 45 Hou	ırs + 30 Hours = 75 Hours)

#### 3. Practicals:

- 1. Practical to implement and analyze matrix multiplication using task and thread-level parallelism on a multicore processor.
- 2. To implement an edge detection algorithm (e.g., Sobel filter) using CUDA, leveraging SIMT architecture and memory-level parallelism.
- 3. Practical to implement the classic producer-consumer problem using semaphores to manage synchronization between multiple threads.
- 4. To implement parallel merge sort using task-based parallelism and analyze task dependencies and performance.
- 5. To evaluate how power-aware processing techniques (like Dynamic Voltage and Frequency Scaling DVFS) affect CPU performance, energy consumption, and latency under different workloads.
- 6. Practical to implement parallel matrix multiplication using OpenMP, demonstrating the concepts of parallelism, synchronization, and mutual exclusion in shared-memory systems.
- 7. Practical Based on Distributed Sorting Using MPI
- 8. Practical to analyze the performance of CUDA cores by implementing a parallel vector addition algorithm, focusing on thread organization, memory hierarchy (global, shared, and register memory), and communication within GPU threads

#### 4. Books Recommended:

- 1. John L. Hennessy and David A. Patterson, "Computer Architecture -- A Quantitative Approach", 5th Edition, Morgan Kaufmann Publishers, 2017, ISBN 13: 978-0-12-383872-8.
- 2. Barbara Chapman, Gabriele Jost and Ruud van der Pas, "Using OpenMP: portable shared memory parallel programming", The MIT Press, 2008, ISBN-13: 978-0-262-53302-7.
- 3. Pacheco S. Peter, "Parallel Programming with MPI", Morgan Kaufman Publishers, 1992, Paperback ISBN: 9781558603394.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

TO B

er Mt

Breez & coases

4. Marc Snir, Jack Dongarra, Janusz S. Kowalik, Steven Huss-Lederman, Steve W. Otto, David W. Walker, "MPI: The Complete Reference, Volume2", The MIT Press, 1998, ISBN: 9780262571234.

5. Pacheco S. Peter, "Parallel Programming with MPI", Morgan Kaufman Publishers, 1992, Paperback ISBN: 9781558603394.

6. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 — last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

N/P

l~ M

pro Saw

### Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

IPG. III (AI) Semester-VI		L	Т	Р	Credit
Cyber-Physical Systems					
IA304	Scheme	3	0	0	3

1. C	ourse Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Understand the fundamental principles of Cyber-Physical Systems.
CO2	Identify the key components and architecture of CPS.
CO3	Apply basic design principles for creating CPS.
CO4	Understand real-time computing and communication constraints in CPS.
CO5	Analyze and apply CPS in real-world application domains.

2.	<u>Syllabus</u>				
	Introduction to Cyber-Physical Systems	(04Hours)			
	Definition and characteristics of CPS, Historical development of CPS and their importance, Key examples of CPS: Autonomous vehicles, industrial automation, healthcare, smart grids, smart cities, Overview of CPS architecture: physical components, computational systems, communication networks, Difference between classical systems and CPS				
	Core Components of Cyber-Physical Systems	(05 Hours)			
	Physical Components: Sensors, actuators, embedded systems, and hardware platforms, Con Components: Embedded processors, real-time operating systems, and software algorithms, Networks: Wired and wireless communication, IoT protocols, and network latency, Feedbac Interaction between physical systems and their digital counterparts	Communication			
	Cyber-Physical Systems Architecture	(08 Hours)			
	System Architecture Models: Layered architecture (perception, control, and actuation layers), Data Flow in CPS: Sensing, processing, decision-making, and actuation, Integration Challenges: Synchronization of physical and computational processes, system interdependence, Edge and Cloud Computing in CPS: The role of distributed computing				
	Real-Time Systems and Constraints in CPS	(08 Hours)			
	Real-time computing and control in CPS, Timing constraints: Deadline-sensitive tasks, sched resource allocation, Real-time operating systems (RTOS) and their role in CPS, Handling dela	uling, and ly, jitter, and			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

W & WH

Pru Jan X

### Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

ystems	(08 Hours)
ensors and Actuators III CF3	(00.110.110.1
ypes of sensors: Temperature, pressure, motion, proximity, etc., Sensor calibration and data echniques, Actuators and control techniques: Combining data from multiple sensors to imp nd decision-making, Wireless sensors and Internet of Things (IoT) in CPS, Real time sensing ommunication	rove accuracy
Communication Protocols for CPS	(08 Hours
Vired and wireless communication technologies in CPS, IoT protocols (e.g., MQTT, Communication latency, bandwidth, and throughput, Security and privacy issues in CPS of Network topology and design considerations for distributed CPS	communication
Applications and Case Studies	(04 Hours)
mart Grids, Autonomous Vehicles, Healthcare CPS, Industrial CPS (Industry 4.0), Autonomo	ous Systems and
-	echniques, Actuators and control techniques: Combining data from multiple sensors to impend decision-making, Wireless sensors and Internet of Things (IoT) in CPS, Real time sensing communication  communication Protocols for CPS  Wired and wireless communication technologies in CPS, IoT protocols (e.g., MQTT, communication latency, bandwidth, and throughput, Security and privacy issues in CPS detwork topology and design considerations for distributed CPS  Applications and Case Studies

#### 3. Books Recommended:

- 1. Cyber-Physical Systems: From Theory to Practice by Rajesh K. Gupta and Phillip A. Laplante
- 2. Principles of Cyber-Physical Systems Rajeev Alur
- Machine Learning for Cyber-Physical Systems" by Nuno J. G. Gomes
- 4. Introduction to Embedded Systems A Cyber— Physical Systems Approach" E. A. Lee, Sanjit Seshia
- 5. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

m & mat

Rear Scoul &

IPG III (AI) Semester - VI BIG DATA ANALYTICS & VISUALIZATION		l.	т	Р	Credit
IA306	Scheme	3	0	2	04

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	To learn the basics of big data, its characteristics, big data management issues, processing and applications with the help of big data platforms and storage models for big data management
CO2	To learn the management and analysis of big data using technology like Hadoop, NoSql, MapReduce, PIG & HIVE
CO3	To apply the data mining algorithms on big data for scalability of the real time applications.
CO4	To develop research interest towards advances in data mining by analyzing the available approaches with the help of evaluating parameters.
CO5	To Visualize big data to perform decision making in real world problems

2.	Syllabus				
	INTRODUCTION	(04 Hours)			
	Definition of Big Data, Source of Big Data, Convergence of Key Trends, Unstructured Data, Industry Examples of Big Data, Web Analytics, Fraud and Risk Associated with Big Data, Credit Risk Management, Big Data in Algorithmic Trading, Healthcare, Medicine, Marketing and Advertising, Big Data Technologies, Introduction to Hadoop and Spark, Open Source Technologies, Cloud, Mobile Business Intelligence, Crowd Sourcing Analytics, Inter and Trans Firewall Analytics.				
	BIG DATA ANALYTICS	(06 Hours)			
	Big Data Processing: Batch Data Processing and Stream Data Processing, Computing Environments for Big Data Analytics, Implementation of Batch and Real Time Event Processing: Integration of Disparate Data Stores/Data Lake, Mapping Data to the Programming Framework, Connecting and Extracting Data from Storage, Transforming Data for Processing, Querying.				
	DISTRIBUTED FILE SYSTEM HADOOP	(08 Hours)			
	Introduction, HDFS Daemons, Different Methods to HDFS Access, Hadoop, Features, Google File System Features, Phases involved in Map Reduce, Architecture, Execution of MapReduce Jobs, Monitoring the progress of job flows, Building Blocks of Hadoop MapReduce. Data				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 — last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat

M B Hz li gor go

BIG DATA ANALYSIS WITH HBASE, SPARK, HIVE and PIG	(08 Hours
HBase, Data Model and Implementations, HBase Clients, HBase Example Cassandra data Model, Cassandra Examples, Cassandra Clients, Hadoop Types and File Formats, HiveQL Data Definition, HiveQL Data Manipulation Applications on Big Data Using Pig and Hive, Data Processing Operators in of ZooKeeper, K-Means Clustering, Decision Trees, Random Forests, Reconspark, Higher Level Declarative Programming, Network Structure, Comp	Integration, Hive, Data on, HiveQl. Queries, in Pig, Fundamentals ommenders, Table in
BIG DATA STORAGE MODELS	(08 Hours
Introduction, NoSQL Databases, Need, Types, Comparison with RDE Features Databases: Distributed Hash-table, Key-Value Storage Mo Language, Document Storage Model, Graph Models, Lambda Archite Design and Provision Compute Resources, Storage Streaming Units, Co for Latency and Throughput, Output Visualization	ecture, Data Ingestion
INTRODUCTION TO DATA VISUALIZATION	(05 Hours
Data Visualization, Design, Data and Tasks, Data Types, Dataset Types, F	Basic Charts and Plots,
Use of Statistical Indicators, Multivariate Data Visualization, Principles of Design, and Evaluation, Graphical Integrity, Data-Ink Ratio, Aspect Ratio Formats-Static Graphs, Interactive Graphs, Infographics, Websites, Anim Strategies-Qualitative and Text-Based Data, Color-Coding, Timelines, Ca Filtering, Parallel Coordinates, Aggregation.	If Perception, Color, s & Scales. nated Videos, GIFs.
Design, and Evaluation, Graphical Integrity, Data-Ink Ratio, Aspect Ratio Formats-Static Graphs, Interactive Graphs, Infographics, Websites, Anin Strategies-Qualitative and Text-Based Data, Color-Coding, Timelines, Ca	If Perception, Color, s & Scales. nated Videos, GIFs. alendars, and Diagram
Design, and Evaluation, Graphical Integrity, Data-Ink Ratio, Aspect Ratio Formats-Static Graphs, Interactive Graphs, Infographics, Websites, Anim Strategies-Qualitative and Text-Based Data, Color-Coding, Timelines, Ca Filtering, Parallel Coordinates, Aggregation.	of Perception, Color, s & Scales. The hated Videos, GIFs. The lendars, and Diagrams  (06 Hours)  Formation, Visualization Principles and Designalitatively Evaluation, Rapidly Prototypion, Rapidly Prototypion.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat

M

Pront Same

3.	Practicals
1	Working with various functions of Hadoop MapReduce.
2	Develop a MapReduce program to calculate the frequency of a given word in agiven file.
3	Working with pySpark and RDDs.
4	Develop a Java application to find the maximum temperature using Spark
5	Regression and classification in Spark.
6	Data analysis with PCA in Spark.
7	Write queries to sort and aggregate the data in a table using HiveQL.
8	Develop a program to calculate the maximum recorded temperature by yearwise for the weather dataset in Pig Latin
9	Hands-on with MLlib and SparkSQL.
10	Use cases and implementation for Big data management and large scale machine learning algorithms.

4.	Books Recommended
1.	Tom White, "HADOOP: The definitive Guide", O Reilly 2012
2.	Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
3.	Alberto Cairo, "The Truthful Art: Data, Charts, and Maps for Communication" 1/E, Berkeley, California: New Riders, 2016, ISBN: 9780321934079
4.	Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, "Advanced Analytics with Spark", O'Reilly.
5.	Jure Leskovec, Stanford Univ. AnandRajaraman, Milliway Labs, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat



b

W W

Product &

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG. III (AI) Semester – VI		L	Т	Р	Credit
IMAGE PROCESSING AND COMPUTER VISION IA308	Scheme	3	0	2	04

	ourse Outcomes (COs):
At the	end of the course, students will be able to
CO1	understand building approaches of digital image processing systems, image models and
	Mathematical tools for image processing.
CO2	apply spatial filtering, frequency domain filtering, image restoration and color image
001	processing Techniques for over all image improvement.
CO3	analyse various image compression methods for effective storage management without
003	Degrading the image quality.
CO4	evaluate various morphology, segmentation and object recognition methods to gain high level
CO-1	of understanding of content of an image.
CO5	create an image processing application in the development of computer vision, machine
COS	learning, deeplearning domains.

2.	Syllabus				
	INTRODUCTION	(04 Hours)			
	Image Model, Image Sensing and Acquisition, Sampling and Quantization, Mathematical Tool for Digital Image Processing, Types of Digital Images, Image File Formats, Colour Fundamentals and Models.				
	INTENSITY TRANSFORMATION AND SPATIAL FILTERING	(07 Hours)			
		of Spatial Filtering,			
	Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Smoothing and Sharpening Spatial Filters.	Spatial Filtering,			
	Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Smoothing and Sharpening Spatial Filters.  FILTERING IN FREQUENCY DOMAIN				
	Smoothing and Sharpening Spatial Filters.	(06 Hours)			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

P Lacel

h M

Benga

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

for Noise Reduction, Linear Position-Invariant Degradations, Estimating the Degradation F Image Reconstruction from Projection. Color Models, Color Transformation, Smoothing	unction, Filtering,
IMAGE COMPRESSION	(06 Hours)
Lossless Compression Algorithms, Lossy Compression Algorithms, Image and Video Comp	es of Redundancy, ression Standards
MORPHOLOGY AND SEGMENTATION	(07 Hours)
and Edge Detection, Thresholding, Region based Segmentation, Segmentation using	ology, Point, Line ng Morphological
ADVANCED TOPICS	(07 Hours)
Image Representation and Description, Object Recognition and Recent Developments.	
Practicals will be based on the coverage of the above topics separately.	(45 Hours)
(Total Contact Time: 45 Hours + 30	Hours = 75 Hours)
	Image Compression Fundamentals, Classification of Image Compression Algorithms, Type Lossless Compression Algorithms, Lossy Compression Algorithms, Image and Video Comp and its Variations.  MORPHOLOGY AND SEGMENTATION  Erosion and Dilation, Opening and Closing, Morphological Algorithms, Grey Scale Morph and Edge Detection, Thresholding, Region based Segmentation, Segmentation usin Watersheds, Use of Motion in Segmentation  ADVANCED TOPICS  Image Representation and Description, Object Recognition and Recent Developments.

#### 3. Practicals:

- 1. Perform image acquisition, sampling, and quantization on a digital image. Convert the image into RGB, Grayscale, and HSV color models and display the results.
- 2. Perform Histogram Processing on a digital image by computing and displaying its histogram, applying histogram equalization, and analyzing the effects on image contrast.
- 3. Implement frequency domain filtering by applying a Low-Pass (Smoothing) and High-Pass (Sharpening) Filter using the Fourier Transform. Analyze the effects on the image.
- 4. Implement and analyze a Lossless Compression Algorithm (e.g., Huffman Coding or Run-Length Encoding) on a grayscale image. Compare the original and compressed file sizes.
- 5. Apply a Lossy Compression Algorithm (e.g., JPEG Compression using Discrete Cosine Transform DCT) on an image. Observe the effects of different compression levels on image quality and file size.
- 6. Perform Morphological Operations (Erosion, Dilation, Opening, and Closing) on a binary image. Analyze their effects on object shapes and noise removal.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Deeel My

Room

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

- 7. Implement Edge Detection and Image Segmentation using Thresholding and Watershed Algorithm. Compare the results of different edge detection techniques (Sobel, Canny, Prewitt)
- 8. Perform Boundary and Region-Based Shape Representation for an object in a binary image. Extract shape descriptors such as area, perimeter, and centroid.
- 9. Implement Feature-Based Object Recognition using corner detection (Harris Corner Detector or FAST) and analyze how well the algorithm detects object features.
- 10. Perform image acquisition and preprocessing, apply histogram equalization for enhancement, use spatial and frequency domain filtering, implement edge detection and segmentation using morphological operations, and finally, apply feature extraction for object recognition in a given image. Analyze the effects of each step.

#### 4. Books Recommended:

- 1. RafaelC.GonzalesandRichardE.Woods, "DigitalImageProcessing", 4/E, PearsonEducation, 2018.
- 2. AnilK.Jain, "Fundamentalsof Digital Image Processing", 1/E, Pearson India, 2015.
- 3. S.Jayaraman, T. Veerakumarand S. Esakkirajan, "Digital Image Processing", 1/E, TMG, 2017
- 4. S.Sridhar, "DigitalImageProcessing", 2/E, OxfordUniversityPress, 2016.
- 5. S.Annadurai, R.Shanmugalakshmi, "Fundamentals of Digital Image Processing", 1/E, Pears on Education, 2006.

Local

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

P My Pri

IPG III (AI) Semester – VI		L	Т	Р	Credit
RESPONSIBLE AI IA352	Scheme	3	0	0	03

1. C	Course Outcomes (COs):	
At the	e end of the course, students will be able to	
CO1	Understand the fundamental concepts of Responsible Al	
CO2	Understand the concept of fairness, privacy, and bias in Al	
CO3	Understand different kinds of risks and ways to mitigate them	
CO4	Understand the explainability of AI systems	
CO5	Apply Responsible AI techniques to different use cases	

2.	Syllabus	
Name of the least	Introduction	(05 Hours)
	Recent Al Capabilities Improvement, imminent risks from Al Models: Toxic misspecification, adversarial examples etc., Long-term risks from Al Models: Misgeneralization, Rogue Artificial General Intelligence	ty, bias, goa dels: Misuse
	Principles of Response AI (RAI)	(05 Hours)
	Transparency, Accountability, Safety, Robustness and Reliability, Privacy and Secand non-discrimination, Human-Centred Values, Inclusive and Sustainable Interpretability	curity, Fairness development
	Types of Risks and Mitigation Strategies	(08 Hours
	Recap of Deep Learning Techniques, Language/Vision Models, Al Risks fo Adversarial Attacks – Vision, NLP, Superhuman Go agents, ML Poisoning Attack Implications for current and future Al safety, Mitigation Techniques	Gen models s like Trojans
	Explainability of Al Systems	( 07 Hours)
	Explainability, Imminent and Long-term potential for transparency technique Interpretability, Representation Engineering, model editing and probing, Critiques of	s, Mechanisti f Transparenc

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Prouved &

Privacy and Fairness	(06 Hours)
Privacy & Fairness in AI, Breaches of Data Privacy, Algorithmic Bias and	Discrimination,
Surveillance and Tracking, Lack of Transparency, Data Security Vulnerabilities	s, Overcoming
Challenges and Safeguarding Privacy in Al	
Evaluation Metrics and Regulations	(07 Hours)
Metrics and Tools for RAI - measuring bias/fairness, adversarial testing (LIME/SHAP/SailencyMap/CAM/GradCam), audit mechanisms, Regulation landsca (India), GDPR (EU), EU AI act, US presidential declaration, Ethical approvals, inforparticipatory design, future of work, Indian context	pe - DPDP act
RAI Use Cases	(07 Hours)
RAI in Legal, Health care, Education and other domains, Policy issues in RAI	
(Total Contact Ti	me: 45 Hours)

#### 3. Books Recommended:

- 1. Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Springer, Virginia Dignum
- 2. The Cambridge Handbook of Responsible Artificial Intelligence, Silja Voeneky et al.
- 3. The Oxford Handbook of Ethics of AI, Markus D. Dubber et al.
- 4. Latest research papers from top tier conferences (ACL, AAAI, TACL etc.)
- 5. Responsible AI: Implementing Ethical and Unbiased Algorithms by Shashin Mishra, Sray Agarwal

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

M

Bros.

Local

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG. III (AI) Semester – VI		L	Т	Р	Credit
DIGITAL FORENSICS					
IA354	Scheme	3	0	0	03

-	Course Outcomes (COs): e end of the course, students will be able to
CO1	get exposure of digital forensic, cryptography and investigation techniques on different computing platforms as well as mobile devices.
CO2	analyze cyber-attacks to assist conventional forensic to investigate digital platforms
CO3	create disk images, recover deleted files and extract hidden information.
CO4	describe the representation and organization of data and metadata within modern computer systems with the use of various forensic tools
CO5	to define research problems and develop effective solutions for digital forensic and can compose a draft which can be used for legal procedure.

2.	<u>Syllabus</u>		
	Introduction	(08 Hours)	
	Introduction to Computer Forensics: Computer Crimes, Evidence, Extraction, Preservation, Analogies to Traditional Forensics and Differences from Traditional Forensics, Hardware and Operating Systems: Structure of Storage Media/Devices; Windows / Macintosh / Linux Registry, Boot Process, File Systems, File Metadata, Identifying Hidden Data, Encryption/Decryption, Steganography, Recovering Deleted Files		
	Digital Evidence on Windows System	(06 Hours)	
	Deleted Data, File Carving, Hibernation, Sleep, Hybrid Sleep, Registry Structure, Attrib Devices, Print Spooling, Recycle Bin, Date and Time Stamp, Thumbnail Cache, Restore Points Link Files.		
	Digital Evidence on Unix System	( 04 Hours)	
	UNIX Boot Disk, File System, Data Recovery, Log Files, File System Traces, Internet Traces.	· ·	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

B

fr My

Prann Socret

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Network Forencis	(05 Hours)
Collecting and Analysing Network-Based Evidence, Reconstructing Web Browsing, Ema Windows Registry Changes, Intrusion Detection, Tracking Offenders, etc.	ail Activity, and
Internet and email Forensics	(07 Hours)
Internet Overview, Role of Internet in Criminal Investigation, Online Anonymity and Self I Technology, Web Browsers, Cookies, Cache, History, Browser Artifacts in Registry, Cha Protocols, Email Evidence, Tracing Email, Email Forgery, Social Networking Sites	
Mobile Device Forensics	(07 Hours)
Cellular Network-Basics-Components-Types, Mobile Operating Systems, Cellphone Evic Records-Collection-Handling-Subscriber Identity Modules-Cellphone Acquisition, Cellphone GPS.	
Software Reverse Engineering	(08 Hours)
Software Reverse Engineering Defend Against Software Targets for Viruses, Worms and Improving Third-Party Software Library, Identifying Hostile Codes-Buffer Overflow, Provisio Inputs, etc.	
	Time: 45Hours)

#### 4. Books Recommended:

- 1. Eoghan Casey, "Digital evidence and computer crime: Forensic science, computers, and the internet", 3rd Edition, Academic press, 2011.
- 2. Dejey and Murugan, "Cyber Forensics", 1st Edition, Oxford University Press, 2018.
- 3. Sammons, John, "The basics of digital forensics: the primer for getting started in digital forensics", 2 nd Edition, Elsevier, 2012.
- 4. Sherri Davidoff, Jonathan Ham, "Network Forensics: Tracking Hackers Through Cyberspace", Prentice Hall, 2012.
- 5. Computer Forensics: Hard Disk and Operating Systems, 2nd Edition, EC Council, September 17, 2009.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In My Port

IPG III (AI) Semester-VI		L	Т	Р	Credit
REINFORCEMENT LEARNING 1A356	Scheme	3	0	0	3

1. C	ourse Outcomes (COs):
At the	end of the course, students will be able to
CO1	Develop a clear understanding of the foundational concepts in RL, such as agents, environments, states, actions, rewards, and policies.
CO2	Learn to model decision-making problems as Markov Decision Processes (MDP).
CO3	Explore advanced algorithms like Deep Q-Networks, Policy Gradient methods, and Actor-Critic models.
CO4	Explore the integration of RL with deep learning to solve high-dimensional and complex problems.
CO5	Apply RL techniques to simulate and solve real-world problems in various domains, such as games, robotics, and finance.

2.	Syllabus	~			
	Introduction to Reinforcement Learning	(06 Hours)			
	Introduction: Origin and history of Reinforcement Learning research. Its connections with other fields and with different branches of ML. Probability Basics: - Axioms of probability, concepts variables, PMF, PDFs, CDFs, Expectation. joint and multiple random variables, joint, condition marginal distributions. Correlation and independence.	of random			
	Markov Decision Processes (MDP)	(06 Hours)			
	Markov Decision Process Introduction to RL terminology, Markov property, Markov chains, Na process (MRP). Bellman equations for MRPs. Markov decision process (MDP), state and action functions, Bellman expectation equations, optimality of value functions and policies, Bellman equations.	n value			
	Dynamic Programming (DP)	(06 Hours)			
	Prediction and Control by Dynamic Programing dynamic programing definition and formulation of point in MDPs, principle of optimality, iterative policy evaluation, policy iteration, value iteration, converge policy evaluation and value iteration algorithms, DP extensions.				
	Monte Carlo (MC) Methods	(06 Hours)			
	Basics of Monte Carlo Methods, First-visit vs. Every-visit MC, model free RL, Monte Carlo control, Or and off policy learning, Importance sampling, Monte Carlo for control: Exploring starts and ε-greedy				

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

O fr

MA

four Love

### Integrated B.Tech. (Artificial Intelligence) and M.Tech (Artificial Intelligence)

methods.  Temporal Difference (TD) Learning	(06 Hours)
Incremental Monte Carlo Methods for Model Free Prediction, Overview TDe estimators, unified view of DP, MC and TD evaluation methods, TD Control and their variants.	(0), TD(1) and TD(λ), k-step methods - SARSA, Q-Learning
Function Approximation Methods	(09 Hours)
Getting started with the function approximation methods, Revisiting risk m	inimization, gradient descent
Getting started with the function approximation methods, Revisiting risk m from Machine Learning, Gradient MC and Semi-gradient TD(0) algorithms, I approximation, Afterstates, Control with function approximation, Least squ Q-Networks. Deep-Reinforcement Learning Need and Applications, Types o (DQN), Policy Gradient [Advantage Actor-Critic (A2C/A3C), DDPG, PPO], A Policy Gradients	Eligibility trace for function ares, Experience replay in deep f Deep-RL : Deep Q-Network

#### 3. Books Recommended:

- 1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2n Edition MIT Press
- 2. Marco Wiering and Martijn van Otterlo, Eds , Reinforcement Learning: State-of-the-Art, Springer Science & Business Media ,2012
- 3. Deep Reinforcement Learning Hands-On, 2nd Edition by Maxim Lapan, 2018.
- Reinforcement Learning with OpenAl Gym" by Alessio Stalla
- 5. Hands-On Reinforcement Learning with Python by Sudharsan Ravichandiran

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

P

er M

Rr. Dogs

D

IPG III (AI) Semester – VI INTRODUCTION TO LARGE LANGUAGE MODELS		L	Т	Р	Credit
IA358	Scheme	3	0	0	03

course Outcomes (COs): end of the course, students will be able to
Understand the fundamental concepts of Large Language Models and its applications.
Understand and Implement different types of language models
Apply various word embeddings, neural language models, and other deep learning methods for different tasks.
Build and evaluate LLMs for different tasks such question answering, dialog systems, summarization, code generation
Utilize LLMs using transformers, Pytorch, HuggingFace, Ollama libraries
Design and implement a complete project using LLMs

2.	Syllabus	
	Introduction	(05 Hours)
	Introduction to NLP, NLP Pipeline, Applications of NLP, Introduction to Stati Models, Statistical Language Models: Advanced Smoothing and Evaluation	tical Language
	Introduction to Deep Learning and Word Representations	(08 Hours)
	Introduction to Deep Learning (Perceptron, ANN, Backpropagation, CNN), Introduct Word2Vec, GloVe, fastText, Tokenization Strategies, Byte Pair Encodings, Subwor Unsupervised Representations	
	Word2Vec, GloVe, fastText, Tokenization Strategies, Byte Pair Encodings, Subwor	
	Word2Vec, GloVe, fastText, Tokenization Strategies, Byte Pair Encodings, Subwor Unsupervised Representations	d Embeddings, (08 Hours) n search, Other

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Ph In My Par Love

Transformers using PyTorch	elementation of	
Transformer Architectures and Fine-Tuning Strategies	(09 Hours)	
ELMo, BERT (Encoder-only Model), GPT (Decoder-only Model), T5 (Encoder-definition to HuggingFace, Instruction Fine-tuning, Instruction Fine-tuning	intext Learning	
Retrieval-Augmented Inference and Generation	(05 Hours)	
Introduction to Knowledge Graphs, Distinction between graph neural networks and neural KG inference, Retrieval augmentation techniques: Key-value memory networks in QA for simple paths in KGs, pointer networks, reading comprehension, REALM, RAG		
Overview of Recently Popular Models	(06 Hours)	
 GPT-4, Llama-3, Claude-3, Code-Llama, Mistral, and Gemini, Multi-modal LLMs - VLA Ethical NLP – Bias and Toxicity, Evaluation Benchmarks	LLaVa, Open-	
(Total Contact Ti	me: 45 Hours)	

#### 3. Books Recommended:

- 1. Tanmoy Chakraborty, Introduction to Large Language Models, Wiley India, 1st Edition, 2025. ISBN: 9789363864740
- 2. Dan Jurafsky and James H. Martin, Speech and Language Processing, 2nd and 3rd edition, Pearson Press, 2008.
- 3. Jacob Eisenstein, Natural Language Processing, First edition, The MIT Press, 2019.
- 4. Practical Natural Language Processing, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, O'Reilly Media, Inc.
- 5. Online Tutorials: Hugging Face, PyTorch, Llama, Ollama, LLMStudio
- 6. Latest research papers from top tier conferences (ACL, NEURIPS, AAAI, NAACL, COLING, CONLL, SIGIR, IJCNLP, LREC, TACL etc.)

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

la Me Proposed

IPG IV (AI) Semester – VII		L.	τ	P	Credit
RESEARCH METHODOLOGY			1	0	03
IA403	Scheme	1.	1	U	02

Course Outcomes (COs): e end of the course, students will be able to
to understand the different research methodologies in different areas.
be able to apply the concepts in writing, presentation, and simulating different experiments.
be able to analyze the proposed work with existing approaches in the literature and interpret the research design through project development and case study analysis using appropriate tools
be able to execute the technical presentation, and organization in writing the report and papers.
be able to design the algorithms and proof learned and communicate effectively through proper organization and presentation.

2. Sylla	<u>abus</u>	
INTI	RODUCTION	(02 Hours)
of R	earch: Definition, Characteristics, Motivation and Objectives, Research Methods vs N tesearch – Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualita pirical.	Methodology, Types itive, Conceptual vs
ME	THODOLOGY	(02 Hours)
Res	Research Questions,	
LITE	ERATURE REVIEW	(02 Hours)
Review Concepts and Theories, Identifying and Analyzing the Limitations of Different Ap		proaches.
	RMULATION AND DESIGN	( 02 Hours)
Con	ncept and Importance in Research, features of a Good Research Design, Exploratory ncept, Types and Uses, Descriptive Research Designs, Concept, Types and Uses, Expe ncept of Independent & Dependent Variables	Research Design, rimental Design:
	TA MODELING AND SIMULATIONS	(02 Hours)
Ma	thematical Modeling, Experimental Skills, Simulation Skills, Data Analysis and Interp	retation.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30—last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

BAL

M

300

Rassel



Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

TECHNICAL WRITING AND TECHNICAL PRESENTATIONS	(02 Hours)
CREATIVITY AND ETHICS IN RESEARCH, INTELLECTUAL PROPERTY RIGHTS	(01 Hours)
TOOLS AND TECHNIQUES FOR RESEARCH	(02 Hours)
Methods to Search Required Information Effectively, Reference Management Formatting, Software for Detection of Plagiarism.	nt Software, Software for Paper
(Total Contact Time:	15 Hours+ 15 Hours = 30 Hours)

3. Tutorials:	
1. Introduction to Research Methodology	
2. Research Design and Its Types	
3. Sampling Techniques	
4. Data Collection Methods	
5. Literature Review and Referencing	
6. Qualitative Research Methods	
7. Quantitative Research Methods	
8. Data Analysis and Interpretation	
9. Writing a Research Proposal	
10. Reporting and Publishing Research	

#### 4. Books Recommended:

- John W. Creswell, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches", SAGE Publications Ltd.
- 2. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers.
- 3. David Silverman,"Qualitative Research", SAGE Publications Ltd.
- 4. Norman K. Denzin and Yvonna Sessions Lincoln," Handbook of Qualitative Research", SAGE Publications Ltd.
- 5. Michael Quinn Patton," Qualitative Research and Evaluation Methods", SAGE Publications Ltd.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)





M

Brown, Sosel



### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

### Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester VII		L	Υ	Р	Credit
ROBOTICS AND ITS APPLICATIONS 1A405	Scheme	3	0	2	04
11.105	0.0019850			L	

ourse Outcomes (COs):
end of the course, students will be able to  Apply fundamental principles of mathematics, science, and engineering to analyze and model robotic systems.
Design and implement robot control algorithms for various robotic tasks.
Utilize computer vision and machine learning techniques for robot perception and navigation.
Evaluate and select appropriate robotic systems for specific applications.
Develop and execute robot programs in simulation and/or on physical robotic platforms.
Analyze the ethical and societal impact of robotics and Al.

2.	<u>Syllabus</u>	TOTAL STREET STREET
	Introduction	(05 Hours)
***	What is a robot? History and evolution of robotics, Types of robots: Industrial, service, mo Basic components of a robot: Manipulators, actuators, sensors, control systems, Applica various fields: Manufacturing, healthcare, exploration, etc., Introduction to Robot Operati	tions of robotics in
	THE PROPERTY OF THE PROPERTY O	200
	Robot Kinematics	(08 Hours)
	Robot Kinematics  Coordinate frames and transformations, Forward kinematics: Denavit-Hartenberg (DH) p kinematics: Analytical and numerical solutions, Jacobian matrix and singularities, Mobile Differential drive, Ackermann steering.	arameters, Inverse
	Coordinate frames and transformations, Forward kinematics: Denavit-Hartenberg (DH) p kinematics: Analytical and numerical solutions, Jacobian matrix and singularities, Mobile	arameters, Inverse e robot kinematics:
	Coordinate frames and transformations, Forward kinematics: Denavit-Hartenberg (DH) p kinematics: Analytical and numerical solutions, Jacobian matrix and singularities, Mobile Differential drive, Ackermann steering.	e robot kinematics:

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Blank Agassi

### Sardar Vallabhbhai National Institute of Technology (SVNIT) Surat

### Department of Artificial Intelligence Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Control system fundamentals: Feedback control, PID control, Robot arm control operational space control, Mobile robot control: Path following, trajectory tracking learning control (brief introduction)	l: Joint space control, g, Adaptive control and
Robot Perception	(07 Flours)
Introduction to computer vision: Image processing, feature extraction, 3D vision: vision, Object recognition and tracking, Sensor fusion	Depth sensing, stereo
Robot Planning	(05 Hours)
Path planning: Search algorithms (A*, Dijkstra's), sampling-based methods ( Trajectory generation, obstacle avoidance, Task planning: Hierarchical planning, task	RRT),Motion planning: decomposition
Al in Robotics	(05 Hours)
Introduction to machine learning for robotics, Reinforcement learning for robot Natural language processing for human-robot interaction, Ethical and societal implica-	control and navigation, ations of AI in robotics
Practicals will be based on the coverage of the above topics separately.	(30 Hours)
(Total Contact Time: 45 Hours	+ 30 Hours = 75 Hours)

Practicals:	
Introduction to ROS and Robot Simulation	
Robot Kinematics and Control	AND THE PERSON NAMED OF THE PERSON
. Computer Vision for Robotics	P. S. C.
. Robot Navigation	THE RESERVE OF THE PARTY OF THE
. Robot Planning	COLUMN TO THE PERSON OF THE PE
. Robot Programming	Pro- And Annual State St
. Robot Applications	
. Integrating different modules (perception, planning, control)	No. of Street,
. Frameworks: ROS (Robot Operating System), Gazebo (Robot Simulator), OpenCV (Computer Vision I yTorch	.ibrary),

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Bland Rose

#### 4. Books Recommended:

- 1. Introduction to Robotics: Mechanics, Control, and Design by John J. Craig
- 2. Robotics: Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, and Giuseppe Oriolo
- 3. Robot Dynamics and Control by Mark W. Spong, Seth Hutchinson, and M. Vidyasagar
- 4. Probabilistic Robotics by Sebastian Thrun, Wolfram Burgard, and Dieter Fox
- 5. ROS for Robotics Programming by Lentin Joseph

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

of the Socool

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VII		L	T	Р	Credit
System Software IA451	Scheme	3	0	0	3

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	Understand systems software components, finite automata, regular expression and context free grammar.
CO2	Apply the knowledge of assembler and macro processors to convert assembly language into machine code.
CO3	Analyze working phases of Compiler, various parsing techniques, semantic analysis, Error handling, code generation and code optimization techniques to undertake meaningful language translation.
CO4	Evaluate Linkers, Loaders, interpreters and debugging methods to manages system memory and provide a portable runtime environment.
CO5	Create a language translator application and mimic a simple compiler.

2.	Syllabus	
	INTRODUCTION	(05 Hours)
	Introduction to System Software, Utility Software, Systems Programming, Rec Software Development, Programming Languages and Language Processors, Data Language Processing.	ent Trends in Structures for
		(06 Hours)
	ASSEMBLERS	
	Overview of the Assembly Process, Cross Assembler, Micro Assembler, Meta Assembler, Two Pass Assembler, Design of Operation Code Table, Symbol Table, Advanced Assembly Process.	embler, Single
	Overview of the Assembly Process, Cross Assembler, Micro Assembler, Meta Assembler, Two Pass Assembler, Design of Operation Code Table, Symbol	embler, Single
	Overview of the Assembly Process, Cross Assembler, Micro Assembler, Meta Assembler, Two Pass Assembler, Design of Operation Code Table, Symbol Table, Advanced Assembly Process.	embler, Single Table, Literal (06 Hours) Reference, within Macros, cro Definition

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat

h

2

Phases of Compiler, Analysis-Synthesis Model of Compilation, Interface with Inc	out, Parser and	
Symbol Table, Token, Lexeme, Patterns and Error Reporting in Lexical Analysis,	Programming	
Language Grammars, Classification of Grammar, Ambiguity in Grammatical Spe	cification, Top	
Down Parsing, Recursive Descent Parsing, Transformation on The Grammars, Pred	dictive Parsing,	
Bottom Up Parsing, Operator Precedence Parsing, LR Parsers, Language Processor	Development	
Tools – LEX & YACC, Semantic Gap, Binding and Binding Times, Memory Allocatio	n, Compilation	
of Expression, Intermediate Representations, Basic Code Optimization.		
LINKERS AND LOADERS	(06 Hours)	
Design of a Linker, Program Relocation, Linking of Overlay Structured Program	ams, Dynamic	
Linking, General Loader Schemes, Absolute Loader, Relocating Loader, Dyn	namic Loader,	
Bootstrap Loader, Linking Loader, other Loading Schemes, Linkers v/s Loaders.		
INTERPRETERS & DEBUGGERS	(06 Hours)	
Overview of Interpretation and Debugging Process, Types of Errors, Classification		
Dynamic/Interactive Debugger, The Java Language Environment, Java Virtual		
Recent Developments.		
(Total Contact Time: 45 Ho		
	LINKERS AND LOADERS  Design of a Linker, Program Relocation, Linking of Overlay Structured Program Linking, General Loader Schemes, Absolute Loader, Relocating Loader, Dyn Bootstrap Loader, Linking Loader, other Loading Schemes, Linkers v/s Loaders.  INTERPRETERS & DEBUGGERS  Overview of Interpretation and Debugging Process, Types of Errors, Classification Dynamic/Interactive Debugger, The Java Language Environment, Java Virtual Recent Developments.	

3.	Books Recommended
1.	D. M. Dhamdhere, "Systems Programming", 6/E, McGraw Hill, 2014.
2.	Leland L. Beck, "System Software - An Introduction to System Programming", 3/E, Pearson Education, 2002.
3.	John Donovan, "Systems programming", 1/E, McGraw Hill, 2017.
4.	Santanu Chattopadhyay, "System Software" 1/E, Prentice-Hall India, 2007.
5.	A. V. Aho, R. Sethi & J D. Ullman, "Compilers-Principles, Techniques and Tools", 2/E, Pearson India, 2013.

P ML fr

Pr Jacob

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

urat (A

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VII INFORMATION RETRIEVAL		L	Т	Р	Credit
IA455	Scheme	3	0	0	03

_	Course Outcomes (COs): le end of the course, students will be able to	
CO1	understand the fundamentals of Information Retrieval (IR) systems	
CO2	apply text processing and indexing techniques for efficient retrieval	
CO3	analyze ranking models and evaluation metrics in IR	
CO4	implement machine learning techniques for IR tasks	
CO5	explore advanced and next-generation IR techniques	

2.	Syllabus		
	Introduction	(06 Hours)	
	Overview of Information Retrieval Systems: Definition and objectives of IR systems, Functional overview of IR systems, Relationship with Database Management Systems, Digital Libraries, and Data Warehouses. Fundamentals of Information Retrieval: History and evolution of IR, Components of an IR system, Key issues in IR.		
	Text Processing and Indexing	(07 Hours)	
	Basic Text Processing: Tokenization, Stopwords, Stemming, Lemmatization, Zipf's law, Detection and Correction: Hamming distance, Longest Common Subsequence, Levensht Indexing and Data Structures: Soundex algorithm, Inverted File Structure, N-Gram Data Str	ein edit distance,	
	Ranking Models	(06 Hours)	
	Ranking Models: Vector Space Model, TF-IDF, Probabilistic Retrieval Model, Generative Model, Probabilistic Ranking Principle, Binary Independence Model		
	Evaluation Metrics and Relevance Judgment in Information Retrieval	(05 Hours)	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

B & M

Sceener

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Relevance judgments.	( 06 Hours)			
Unsupervised Learning Approaches in Information Retrieval	( oo nours)			
Retrieval using Unsupervised Techniques: Word embeddings, Clus	tering-based retrieval, Topic modeling),			
Dimensionality reduction techniques, Anomaly detection in retrieva				
Supervised Learning Approaches in Information Retrieval	( 06 Hours)			
Learning to Rank for retrieval, Classification-based retrieval, Neural networks for ranking, Deep learning				
Learning to Rank for retrieval, Classification-based retrieval, Neur	ral networks for ranking, Deep learning			
Learning to Rank for retrieval, Classification-based retrieval, Neumodels (e.g., BERT, Transformer-based retrieval), Feature engi				
models (e.g., BERT, Transformer-based retrieval), Feature engi				
models (e.g., BERT, Transformer-based retrieval), Feature engi retrieval.	ineering for IR, Ensemble methods in			

#### 4. Books Recommended:

- 1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze. Introduction to Information Retrieval, Cambridge University Press, 2008. ISBN-13: 978-0521865715.
- 2. Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack. Information Retrieval: Implementing and Evaluating Search Engines, MIT Press, ISBN-13: 978-0262026512.
- 3. Jure Leskovec, Anand Rajaraman , Jeffrey D. Ullman. Mining of Massive Datasets, Cambridge University Press, 2011. ISBN: 978-1107077232.
- 4. Information Storage & Retrieval By Robert Korfhage John Wiley & Sons.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Phy Doese

### Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VII Internet of Things and Edge Computing		L	т	Р	Credit
IA453	Scheme	3	0	0	3

1.	Course Outcomes (COs): At the end of the course, students will be able to
CO1	Identify the hardware and software components, challenges of Internet of Things
CO2	Assess different Internet of Things technologies, architectures resource management and their applications.
CO3	Understand fundamentals of Edge computing and its applications in low latency and critical real-time computing scenarios
CO4	Evaluating different techniques for distributed data analytics over edge devices like edge data centre.
CO5	Analyze the performance and issues of the applications developed using edge architecture and platforms.

2.	Syllabus	
	INTRODUCTION	(03 Hours)
	Definition and Characteristics of Internet of Things (IoT) - Challenges and Issues - P of IoT - Logical Design of IoT - IoT Functional Blocks.	hysical Design
	IOT COMMUNICATION ARCHITECTURES AND PROTOCOLS	(05 Hours)
	Control Units – Communication modules – Bluetooth – Zigbee – WiFi – GPS - IoT Pl 6LoWPAN, RPL, CoAP) – MQTT - Wired Communication - Power Sources	rotocols (IPv6
		rotocols (IPv6
	6LoWPAN, RPL, CoAP) – MQTT - Wired Communication - Power Sources	(12 Hours) Introl andData Id Computing Ity: Network

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

lr-

of my MAR PV

Lacces

Introduction to Cloud and its limitations to support low latency and RTT. From Cloud to Edge computing: Waves of innovation. Introduction to Edge Computing Architectures. Edge Computing to support User Applications (5G-Slicing, self-driving cars and more) Concepts of distributed systems in edge computing such as time ordering and clock synchronization, distributed snapshot, etc.			
MANAGEMENT OF EDGE APPLICATIONS AND SERVICES	(10 Hours)		
Introduction to Edge Data Center, Lightweight Edge Clouds and its services provides service providers. Introduction to docker container and Kubernetes in edge comof edge storage systems like key-value stores	ed by different puting. Design		
EDGE PLATFORMS AND USE CASES	(10 Hours)		
Introduction to MQTT and Kafka for end-to-end edge pipeline. Edge analytics M2M and WSN network (MQTT), Use cases of machine learning for edge predictive maintenance, image classifier and self-driving cars. Deep Learn inference at the edge to support latency-based application	sensor data in		
(Total Contact T	\		

3.	Books Recommended
1.	The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2.	S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
3.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 2019, 1 st Edition, Wiley Publications, USA.
4.	Fog and Edge Computing: Principles and Paradigms", Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley, 2019
5.	Cloud and Distributed Computing: Algorithms and Systems", Rajiv Misra, Yashwant Patel, Wiley 2020.

De by Joseph

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat



Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VII		L	Т	Р	Credit
COMPUTATIONAL INTELLIGENCE IA457	Scheme	3	0	0	03

_	Course Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Able to understand different computational techniques
CO2	Able to apply different computational techniques in different domains
CO3	Able to analyze the performance of different computational
CO4	Able to design hybrid computational intelligence models using neural networks, fuzzy logic, and evolutionary algorithms.
CO5	Able to evaluate uncertainty-handling techniques in computational intelligence and their impact on decision-making systems.

2.	Syllabus	
	INTRODUCTION	(06 Hours)
Overview, Basics of Problem solving as an Artificial Intelligence problem, Computational In	ntelligence,	
	INTELLIGENT SEARCH TECHNIQUES, KNOWLEDGE REPRESENTATION	(08 Hours)
	Artificial neural networks: feed-forward, recurrent and multi-layer architectures; Supervi unsupervised learning; Characteristics: adaptability, fault tolerance, generalization	sed and
	COMPUTATIONAL INTELLIGENCE METHODOLOGIES LEARNING, ADAPTATION	(08 Hours)
	limitations of neuro-computing. Different learning algorithms: Perceptron, Backpropagat Kohenen networks.	gation, Hopefield, (08 Hours)
	UNCERTAINTY TREATMENT	
	Fuzzy sets - Basic Definition; Fuzzy-set theoretic Operations - Member Function Formula	tion and
	Parameterization – Fuzzy Rules and Fuzzy Reasoning, Fuzzy If-Then Rules, Hybrid approach	
		ches (neural
	Parameterization – Fuzzy Rules and Fuzzy Reasoning, Fuzzy If-Then Rules, Hybrid approach networks, fuzzy logic, genetic algorithms etc.)	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

& B

MAP P Doce

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Industry, Language, Medicine, Verification, Vision, Knowledge Based Systems etc.		
ETHICAL AND SOCIETAL ASPECTS OF COMPUTATIONAL	LINTELLIGENCE	(04 Hours)
Bias and fairness in AI algorithms, Ethical concerns in ne	eural networks and fuzzy systems	, Societal impacts
of autonomous decision-making		

### 4. Books Recommended:

- 1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall Series in Al, 1995.
- 2. E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill, New Delhi 1992.
- 3. J.S.R.J ang, C.T. Sun and E. Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice Hall of India and Pearson Education, 2004.
- 4. Konar A., "Computational Intelligence: Principles, Techniques and Applications", Springer Verlag, 2005
- 5. S. Rajasekaran and G.A.V. Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice Hall of India, 2003. 6. R. Eberhart, P. Simpson and R. Dobbins, "Computational Intelligence PC Tools", AP Professional, Boston, 1996.

Plr My Rr, Jasos P

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

	L	T	P	Credit
-			100000	
heme	3	0	0	03
heme		3		3 11 11

	Course Outcomes (COs): e end of the course, students will be able to	
CO1	Explain key data mining concepts, techniques, and preprocessing methods.	
CO2	Apply association rule mining to discover patterns in large datasets.	
CO3	Develop and evaluate classification and prediction models.	
CO4	Implement clustering and outlier detection techniques.	
CO5	Utilize data mining for complex applications, including web, text, and big data.	

2.	Syllabus	
	Introduction to Data Mining and Data Preprocessing	(10 Hours)
	Data Mining, Stages of the Data Mining Process, Data Mining Knowledge Representat Discovery in Databases (KDD), Introduction to Data Mining Tasks: Classification, Cluster Rule Mining, Data Preprocessing Techniques: Handling Missing Values, Noisy Data and Warehouse: Basic Concept, Online Transaction Processing (OLTP), Online Analytical Proce	ing, Association I Outliers, Data
	Mining Frequent Patterns, Associations, and Correlations	(05 Hours)
	Basic Concept: Market Basket Analysis, Frequent and Closed Item sets, Frequent Itemset N Apriori Algorithm, Generating Association Rules from Frequent Item sets, Correlation Ana Growth Approach for Mining Frequent Item sets, Pattern Mining in Multilevel, Multidimer	lysis, A Pattern-
	Classification and Prediction	(10 Hours)
	Define Classification: General Approach, Classification Methods: Decision Tree Induction and CART, Naïve Bayes Classification, Classification Advanced Methods: Support Vector Nearest-Neighbor Classifiers, Techniques to Improve Classification Accuracy: Ensemble le boosting, random forests), Model Evaluation: Metrics for Evaluating Classifier Performance Validation.	or Machines, k- arning (bagging, ormance, Cross-
	Cluster Analysis	(10 Hours)
	Overview and Requirements of Cluster Analysis, Partitioning Methods: k-Means, k-Medo Methods: Agglomerative versus Divisive Hierarchical Clustering, Density-Based Met Density-Based Clustering Based on Connected Regions with High Density, Grid-Based N STatistical Information Grid, Evaluation of Clustering: Assessing Clustering Tendency, I Number of Clusters and Measuring Clustering Quality.	hods: DBSCAN: 1ethods: STING:

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: O1 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surať (58th Senate, 31 May 2023)

for B

M

produced description

Data Mining Trends and Research Edges	(10 Hours)
Mining Complex Data Types: Mining Sequence Data: Time-Series, Symbolic Sequences	, and Biological
Sequences, Mining Graphs and Networks, Web Mining and Text Mining, Data Mining Ap	plications, Data
Mining and Recommender Systems, Privacy, Security, and Social Impacts of Data Mining.	
(Total Contact 1	ime= 45 Hours)

#### 4. Books Recommended:

- 1. Han, J., Kamber, M., & Pei, J. (2011). Data Mining: Concepts and Techniques (3rd ed.). Morgan Kaufmann. ISBN: 978-0123814791.
- 2. Tan, P-N., Steinbach, M., & Kumar, V. (2018). Introduction to Data Mining (2nd ed.). Pearson. ISBN: 978-0133128901.
- 3. Rajaraman, A., & Ullman, J. D. (2011). Mining of Massive Datasets (2nd ed.). Cambridge University Press. ISBN: 978-1107077232.
- 4. Gupta, G. K. (2006). Introduction to Data Mining with Case Studies. PHI Learning. ISBN: 978-8120330982.
- 5. Mohammed J. Zaki & Wagner Meira Jr. (2020). Data Mining and Machine Learning: Fundamental Concepts and Algorithms (2nd ed.). Cambridge University Press. ISBN: 978-1108473989.

lu A My

Modes

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



IPG IV (AI) Semester – VII		L	т	P	Credit
SYSTEM ANALYSIS AND SIMULATION IA461	Scheme	3	0	0	03

	course Outcomes (COs): e end of the course, students will be able to
CO1	Understand Discrete Event Simulation and Modeling: Gain knowledge of key elements and principles of discrete event simulation and the modeling paradigm.
CO2	Analyze and Apply Simulation Results: Interpret simulation models and utilize the results to address realworld challenges effectively.
CO3	Perform System Analysis: Identify and evaluate system requirements using various system analysis techniques.
CO4	Utilize Simulation Software: Apply computer simulation tools to solve problems and analyze system behavior.
CO5	Develop and Execute System Models: Acquire skills to construct, implement, and execute goal-oriented system models using simulation software.

2.	Syllabus		
	Introduction to System Development	(09 Hours)	
	System development concepts, Business and organizational context, Information system business, Information system stakeholders, Types of information systems, and the development life cycle).	ms' function in SDLC (system	
	Methods for Project Management and Systems Development	(09 Hours)	
	Software development tools, quality assurance, project planning, scheduling, risk malestimation, and system development methodologies (waterfall, agile, spiral, RAD), as modeling techniques (DFD, UML).	nagement, cost well as system	
	Activities for System Analysis	(08 Hours)	
	Use case modeling, functional and non-functional requirements, feasibility analysi validation, and requirement elicitation methods (interviews, surveys, and prototyping).	s, requirement	
	Fundamentals of System Architecture	(09 Hours)	
	Human-computer interaction (HCI) elements, network design considerations, system hardware and software choices, user interface (UI) and user experience (UX) principles, so and access control systems.		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

lo

MZ

**R**/.

100000

Concepts of Advanced System Design	(10 Hours)
UML design models (class, sequence, and activity diagrams), database design and managem security and integrity, database modeling techniques, system implementation and testing s	
object-oriented design principles (encapsulation, inheritance, and polymorphism).	
(Total Contact Tir	me= 45 Hours)

#### 4. Books Recommended:

- 1. J. W. Satzinger, R. B. Jackson and S. D. Burd, "Systems Analysis and Design in a Changing World", 6th ed. Boston, USA: Thomson Course Technology, 2012.
- Averill M. Law, "Simulation modelling and analysis (SIE)", 4th Edition, Tata McGraw Hill India, 2007.
- 3. David Cloud, Larry Rainey, "Applied Modelling and Simulation", Tata McGraw Hill, India.
- 4. Gabriel A. Wainer, "Discrete-event modelling and simulation: a practitioner's approach", 1st Edition, CRC Press, 2009.
- 5. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, "Theory of modelling and simulation: integrating discrete event and continuous complex dynamic systems", 2nd Edition, Academic Press, 2000.

DID MA

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG. IV (AI) Semester – VIII INTELLIGENT MULTIAGENT AND EXPERT SYSTEMS		L	Т	Р	Credit
IA402	Scheme	3	0	2	04

	Course Outcomes (COs): e end of the course, students will be able to
CO1	understand the fundamentals of multi-agent systems: Grasp the core concepts, architectures, and challenges of multi-agent systems.
CO2	design and implement multi-agent systems: Apply techniques for designing, implementing, and analyzing multi-agent systems.
CO3	apply knowledge representation and reasoning techniques: Utilize knowledge representation languages and reasoning algorithms for building intelligent agents.
CO4	develop expert systems: Design and implement expert systems using various knowledge representation and reasoning techniques.
CO5	evaluate and analyze intelligent systems: Critically evaluate the performance and limitations of intelligent systems, including multi-agent and expert systems.

2.	Syllabus	
	Introduction to Artificial Intelligence and Multi-Agent Systems	(06 Hours)
	Introduction to Artificial Intelligence: What is Al, History and Milestones, Multi-Agent Sys and characteristics, Types of agents: reactive, deliberative, hybrid, Agent architecture. Challenges and limitations	
	Knowledge Representation and Reasoning	(08 Hours)
	Knowledge Representation Languages: Propositional and first-order logic, Semantic ontologies, Frame-based representations, Reasoning Techniques: Inference rules - Modus Tollens, Forward and backward chaining, Uncertainty reasoning: Bayesian networks, fuzzy satisfaction problems	Ponens, Modus
	Multi-Agent Coordination and Negotiation	(07 Hours)

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 - last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

On B MA Pri Joseph

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Coordination Mechanisms: Centralized and decentralized coordination, Task allocation Negotiation and bargaining strategies, Communication Protocols, Message passing and	and scheduling, shared memory,
Cooperation and Competition	(00 11 2 11 2)
Learning in Multi-Agent Systems	(06 Hours)
Reinforcement Learning: Single-agent reinforcement learning, Multi-agent reinforcement Machine Learning Techniques: Supervised learning, Unsupervised learning, Semi-super Learning from Human Behavior: Imitation learning, Apprenticeship learning	ement learning, ervised learning,
	(10 Hours)
Expert Systems	N. 12 W.
Expert System Architecture: Knowledge base, Inference engine, User interface, Exp Knowledge Acquisition Techniques: Knowledge elicitation, Machine learning for knowledge Expert System Applications: Medical diagnosis, Financial analysis	lanation facility, edge acquisition,
Ethical and Social Implications of Multi-Agent and Expert Systems	(08 Hours)
Ethical Considerations: Bias and fairness, Privacy and security, Accountability and transpare Impact: Increase in Productivity, Impact on Jobs, Impact on Policy Design	ency, Social
Practicals will be based on the coverage of the above topics separately.	(30 Hours)
(Total Contact Time: 45 Hours + 30 I	Hours = 75Hours

#### 3. Practicals:

- 1. Introduction to Python for AI: Basic Python Programming Constructs, Numpy, Scipy, Pandas, Matplotlib, Seaborn for Data Processing and Visualization
- 2. Implementing simple rule-based expert system
- 3. Implementing forward and backward chaining algorithms
- 4. Building a Semantic Network with Knowledge Representation and Inference Rules
- 5. Designing a Simple Multi-Agent System using a simulation environment (like MASON, NetLogo)
- 6. Implementing Negotiation Strategies using a negotiation protocol (e.g., FIPA-ACL) to simulate agent negotiation
- 7. Building a Medical Diagnosis Expert System using a knowledge-based system to diagnose diseases based on symptoms and uncertainty reasoning techniques
- 8. Developing a Financial Advisor Expert System

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

er @ Mer. 2000 B

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

- 9. Reinforcement Learning for Multi-Agent Systems to learn optimal policies through interaction with the environment
- 10. Machine Learning for Agent Behavior to learn agent behaviors from data
- 11. Ethical AI Design and Development, Analyzing real-world AI systems for potential biases and harms

#### 4. Books Recommended:

- 1. Russell, S., & Norvig, P. (2016). Artificial Intelligence: A Modern Approach. Pearson.
- 2. Wooldridge, M. J. (2009). An Introduction to MultiAgent Systems. John Wiley & Sons.
- 3. Giarratano, J., & Riley, G. (2021). Expert Systems: Principles and Programming. Cengage Learning.
- 4. Gerhard Welss (1999). Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence
- 5. Victor Dibia (2024). Multi-Agent Systems with AutoGen

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In PMI Rossel

IPG IV (AI) Semester – VIII PROFESSIONAL ETHICS, BUSINESS AND ENTREPRENEURSHIP		L	Т	P	Credit
HU402	Scheme	3	0	0	03

Course Outcomes (COs): e end of the course, students will be able to
Apply ethical principles and professional codes of conduct to resolve ethical dilemmas in business and professional settings.
Evaluate the role of corporate social responsibility (CSR), ethical leadership, and governance in sustainable business practices.
Identify entrepreneurial opportunities, create business models, and formulate strategic business plans for startups.
Manage financial resources, budgeting, and funding sources while understanding the economic impact of entrepreneurship.
Develop leadership skills, problem-solving abilities, and innovative strategies for scaling and sustaining a business.

2.	Syllabus		
	INTRODUCTION TO PROFESSIONAL ETHICS	(06 Hours)	
	Definition, scope, and importance of ethics in professional life, Ethical theories, moral	reasoning, and	
	decision-making frameworks.  BUSINESS ETHICS AND CORPORATE GOVERNANCE	(06 Hours)	
	Corporate social responsibility (CSR) and ethical leadership, Corporate governance pri and legal compliance.	nciples, transparency,	
	FUNDAMENTALS OF ENTREPRENEURSHIP	(07 Hours)	
	Concept, characteristics, and types of entrepreneurs, Role of innovation, risk-taking, a entrepreneurship.	and problem-solving in	
	BUSINESS PLANNING AND STRATEGY	(07 Hours)	
	Components of a business plan and market research, Business models, funding source strategies.	es, and competitive	
	FINANCIAL AND ECONOMIC ASPECTS OF ENTREPRENEURSHIP	(06 Hours)	
	Financial management, budgeting, and cost control, Economic impact, sustainability, for entrepreneurs.		

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

elv P MJ Rose

ETHICAL CHALLENGES IN BUSINESS AND ENTREPRENEURSHIP	(06 Hours)
Ethical decision-making in startups and corporations, Consumer rights, social responstudies on ethical failures.	onsibilities, and case
 LEADERSHIP, INNOVATION AND BUSINESS GROWTH	(07 Hours)
Entrepreneurial leadership and team management, Scaling businesses, crisis mana trends in entrepreneurship.	gement, and emerging
(Total	l Contact Time: 45 Hours)

#### 4. Books Recommended:

- 1. R. Subramanian Professional Ethics Oxford University Press
- 2. Andrew Crane & Dirk Matten Business Ethics: Managing Corporate Citizenship and Sustainability in the Age of Globalization Oxford University Press
- 3. Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd Entrepreneurship McGraw Hill Education
- 4. S.K. Mandal Ethics in Business and Corporate Governance McGraw Hill Education
- 5. Donald F. Kuratko Entrepreneurship: Theory, Process, and Practice Cengage Learning

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In O

M

was Losed

Integrated B.Tech. (Artificial Intelligence) and M.Tech.	(Artificial Intelligence)
--	---------------------------

IPG IV (AI) Semester – VIII HUMAN COMPUTER INTERACTION		L	Т	Р	Credit
IA404	Scheme	3	0	0	03

	Course Outcomes (COs): e end of the course, students will be able to
CO1	Understand the history of HCI, human abilities, interaction styles, and computing paradigms.
CO2	Apply usability concepts and prototyping techniques to design user-friendly GUIs.
CO3	Implement HCI guidelines like Shneiderman's rules, Norman's principles, and Nielsen's heuristics for system evaluation.
CO4	Design dialog systems using FSMs, Petri nets, and model-based techniques like GOMS and Fitts' law.
CO5	Conduct HCI experiments, task modeling (HTA, CTT), and data analysis to improve system usability.

2.	Syllabus			
	HCI foundation	(03 Hours)		
	history, human abilities, state of the art in computing technology, interaction style	s and paradigms		
	Interactive system design	(05 Hours)		
	Concept of usability definition and elaboration, HCI and software engineering, GUI Prototyping techniques	design and aesthetics,		
	Guidelines in HC	(08 Hours)		
	Shneiderman's eight golden rules, Norman's seven principles, Norman's model of ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Co			
	Dialog Design	(05 Hours)		
	Introduction to formalism in dialog design, design using FSM (finite state machines (classical) Petri Nets in dialog design	s), State charts and		
	Model-based Design and evaluation	(08 Hours)		
	Basic idea, introduction to different types of models, GOMS family of models (KLM Fitts' law and Hick Hyman's law, Model-based design case studies	1 and CMN-GOMS),		
	Cognitive architecture, and Design -Case Studies			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Introduction to CA, CA types, relevance of CA in IS design, Model Human Processor (MHP), Case Study Multi Key press Hindi Text Input Method on a Mobile Phone, Case Study 2 - GUI design for a mobile phone based Matrimonial application, Case Study 3 Employment Information System for unorganised construction workers on a Mobile Phone.
Empirical research methods in HCI and task modeling and analysis (08 Ho
Introduction (motivation, issues, research question formulation techniques, Experiment design and data analysis (with explanation of one-way ANOVA), Hierarchical task analysis (HTA), Engineering task mode and Concur Task Tree (CTT)
Total Contact Time: 45 Ho

#### 4. Books Recommended:

- 1. Dix A., Finlay J., Abowd G. D. and Beale R. Human Computer Interaction, 3rd edition, Pearson Education, 2005.
- 2. Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.
- 3. B. Shneiderman; Designing the User Interface, Addison Wesley 2000 (Indian Reprint).
- 4. J. M. Caroll (ed.), HCI Models, Theories and Frameworks: Towards a Multidisciplinary Science (Interactive Technologies), Morgan Kauffman, 2003.

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

en my

Proposed

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VIII DRONE AND AUTOMATION SYSTEMS		L	Т	Р	Credit
IA452	Scheme	3	0	0	03

	course Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Understand Drone Fundamentals – Explain autonomous flight principles and UAV components.
CO2	Analyze Drone Technologies – Evaluate navigation, sensors, communication, and power systems.
CO3	Design UAV Systems – Apply UAV design and feasibility analysis.
CO4	Implement Automation & Control – Develop flight controllers, GPS navigation, and Al-driven automation.
CO5	Apply Safety & Regulations – Demonstrate knowledge of telemetry, FPV, laws, and risk management.

2.	Syllabus			
	Overview of Flight Principles and Autonomous Drones	(08 Hours)		
	Aerodynamics, flight principles, flight maneuvers, control surfaces, and the history of auto- An overview of do-it-yourself drone development and automation applications.	nomous drones.		
	System Components and Drone Technologies	(09 hours)		
	Payloads, sensors, and navigation are essential technologies for drone automation. Com shelf (COTS) drone technologies, communication systems (RF, GPS, telemetry), and pow battery management.	mercial off-the- ver sources and		
	Design and Development of Unmanned Aerial Vehicles (UAVs)	(09 Hours)		
	UAV classifications, successful drone case studies, and conceptual, preliminary, and detail Aspects of UAV development that include automation, propulsion systems (motors, powertrain integration), airframe selection, feasibility analysis, and sequential UAV assem	propellers, and		
	Navigation, Automation, and Control of Drones	(10 hours)		
	Parts, configuration, and setup of flight controllers. systems for GPS, compass, and batt Swarm drone coordination, Al-powered navigation, transmitter frequency bands, aut modes, and real-time automation.	onomous flight		
	Safety, Telemetry, and Business Uses	(09 hours)		
	First-Person View (FPV) systems, camera integration, telemetry radios, and real-time da rules pertaining to flight safety, pre-flight checklists, risk management, commercial drone yourself airframe construction, and upcoming developments in Al-powered UAV automat	ne platforms, do-it-		
	(Total Contact T			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

en @ My

& Dares

#### 4. Books Recommended:

- Terry Kilby and Belinda Kilby Make: Getting Started with Drones, First Edition, Maker Media Inc, San Francisco CA, 2016
- Baichtal, John. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing,
   2016.
- 3. Sadraey, Mohammad H. Design of Unmanned Aerial Systems. Wiley, 2017.
- 4. Jha, A. R. Theory, Design, and Applications of Unmanned Aerial Vehicles. CRC Press, 2016.
- 5. Cardon, Alain, and Mhamed Itmi. New Autonomous Systems. Wiley, 2016.

In A govern Scarce!

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

IPG IV (AI) Semester – VIII ADVERSARIAL MACHINE LEARNING		L	т	P	Credit
IA454	Scheme	3	0	0	00

_	Course Outcomes (COs):
CONTRACTOR OF	e end of the course, students will be able to
CO1	To explain key concepts, including adversarial attacks, defenses, and the role of adversarial learning in AI security.
CO2	To explore white-box, black-box, and gray-box attack strategies, including gradient-based attacks and optimization-based approaches.
CO3	To study and apply adversarial defense techniques such as adversarial training, input preprocessing, model regularization, and robust architectures.
CO4	To assess model vulnerabilities, conduct robustness testing, and use metrics to quantify the impact of adversarial perturbations.
CO5	To implement adversarial learning techniques in domains like cybersecurity, autonomous systems, and healthcare while considering ethical implications.

2.	Syllabus					
	INTRODUCTION TO ADVERSARIAL MACHINE LEARNING	(06 Hours)				
Definition and significance, Threat models in ML security, Categories of adversarial attacks	al attacks					
	ADVERSARIAL ATTACK TECHNIQUES	(07 Hours)				
	White-box vs. black-box attacks, Evasion attacks (FGSM, PGD, CW), Poisoning and	l backdoor attacks				
	DEFENSES AGAINGT ADVERSARIAL ATTACKS	(07 Hours)				
	Adversarial training and robust optimization, Gradient masking and input transformations, Certified robustness techniques					
11	THEORETICAL FOUNDATIONS OF ADVERSARIAL ML	(06 Hours)				
	Perturbation bounds and robustness, Decision boundary analysis, Trade-offs between accuracy and robustness					
	APPLICATIONS AND CASE STUDIES	(06 Hours)				
	Adversarial ML in computer vision and NLP, Security challenges in autonomous systems, Case studies from industry and research					

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

fr D M hour Los

ADVANCED TOPICS IN ADVERSARIAL ML	(07 Hours)		
Explainability and interpretability in adversarial settings, Transferability and	universal adversarial		
perturbations, Generative models and adversarial training			
PRACTICAL IMPLEMENTATIONS AND RESEARCH TRENDS	(06 Hours)		
Benchmarking adversarial robustness, Hands-on attack and defense implem	nentation, Emerging research		
directions and open challenges			
	(Total Contact Time: 45 Hours)		

#### 4. Books Recommended:

- 1. Battista Biggio and Fabio Roli, Adversarial Machine Learning, Now Publishers, 2018.
- 2. Ian Goodfellow, Yoshua Bengio, Aaaron Courville, Franchis Bach, Deep Learning (Adaptive Computation and Machine Learning series), MIT Press, 2017
- 3. P. W. Singer and Emerson T. Brooking, LikeWar: The Weaponization of Social Media, Mariner Books, 2018.
- 4. Nicolas Papernot, Ian Goodfellow, and Patrick McDaniel, *Adversarial Machine Learning: Theory and Practice*, Springer, *Upcoming*
- 5. Daniel Lowd and Christopher Meek, Adversarial Learning, Morgan & Claypool Publishers, 2020.

In DA Proud

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG. IV (AI) Semester – VIII MULTIMEDIA SYSTEM & APPLICATIONS		L	Т	Р	Credit
IA456	Scheme	3	0	0	03

	course Outcomes (COs): e end of the course, students will be able to
CO1	Understand different lossy and lossless compression algorithms.
CO2	Understand the various transforms required to compress images and critically analyze their advantages and limitations.
CO3	Analyze different audio, image and video compression standards and their advance features.
CO4	Understand different protocols of multimedia communication networking and their applications
CO5	Analyze the ways in which multimedia data is transmitted across networks

2.	Syllabus				
	Introduction	(04 Hours)			
	Components of Multimedia System, Multimedia Applications, Description and Architecture of System; System specifications	of Multimedia			
	Multimedia Content and Formats				
	Text, Digital Audio Concepts, Sound MIDI, Audio file formats, Audio and Video Capi Quantization, Image, Audio, and Video formats, Animation	ture, Sampling,			
	Multimedia Content Coding and Comperssion	(12 Hours)			
	Lossy and Lossless Compression, Image, Audio and Video Compression, Huffman Coding, Algorithm, Adaptive Coding, Arithmetic Coding, Higher Order Modeling, Finite Context Mode based Compression, Transform Coding, Case study: LZ77, LZW, JPEG, DCT, MPEG.	Shannon Fano eling, Dictionary			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In D My Prairie. Incoded

\$

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

Multimedia Storage and Retrieval	(08 Hours)
Storage Requirements for Multimedia Data, File Formats and Storage Standards, Multimedia Retrieval Techniques, Content-Based Retrieval (CBIR, CBVR), Cloud Storage for Multimedia Tagging in Multimedia	edia Indexing and lia, Metadata and
Multimedia Server and Access	(06 Hours)
Multimedia Protocols, Services, Interface, Multimedia server and clients, Multimedia on demand, Security Issues.	nedia streaming,
Multimedia Project Development and Management	(05 Hours)
Multimedia Project: stages of project, multimedia skills, design concept, authoring - plann and costing, Multimedia Team.	ing
Emerging Technologies in Multimedia	(04 Hours)
Multimedia-looking towards Future: Digital Communication and New Media, Interactive Broadcasting, Digital Radio, Multimedia Conferencing.	Television, Digital
(Total Contac	t Time: 45 Hours)

#### 4. Books Recommended:

- 1. Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking", Wiley-Interscience, 2006
- 2. Nikil Jayant, "Signal Compression: Coding of Speech, Audio, Text, Image and Video, World Scientific", 1997
- 3. Vasudev Bhaskaran, and Konstantinos Konstantinides, "Image and Video Compression Standards: Algorithms and Architectures", Springer 1997
- 4. Ralf Steinmetz and Klara Nahrstedt, "Multimedia Systems", Springer, 2004
- 5. Khalid Sayood, "Lossless Compression Handbook (Communications, Networking and Multimedia)", 1/E, Academic Press; 2002

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In @ M Promet Scarce &

### Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

IPG IV (AI) Semester – VIII BLOCKCHAIN AND ITS APPLICATION		L	Т	Р	Credit
IA458		3	0	0	03
	Scheme				

1. <u>C</u>	Course Outcomes (COs):
At the	e end of the course, students will be able to
CO1	Understand blockchain architecture, consensus mechanisms, and decentralization.
CO2	Apply cryptographic techniques for secure blockchain operations.
CO3	Develop and deploy smart contracts using Solidity.
CO4	Build decentralized applications (DApps) for real-world use cases.
CO5	Assess blockchain scalability, security, and privacy solutions.

2.	Syllabus				
	Overview of Blockchain Technology	(05 Hours)			
	An overview of blockchain technology, including its blocks and transactions, distribute structure, longest chain rule, cryptocurrency, permissioned versus permissionless blockchain Blockchain 2.0.				
	Smart Contracts and Decentralization	(10 Hours)			
	Decentralization techniques, disintermediation, contest-driven decentralization, framework, wallets, alternative coins, proof of stake, proof of storage, difficulty adjustn and Bitcoin limitations are all examples of blockchain ecosystem components. An overcontracts, smart contract templates, smart oracles, and smart contract deployment.	nent algorithms,			
	Development Tools and Permitted Blockchains	(10 Hours)			
	Consensus mechanisms (Paxos, RAFT, Byzantine General Problem, Practical Byzantine Fault cases, and models of permissioned blockchains. Development tools and frameworks Ganache, MetaMask, Truffle, Solidity compilers, IDEs, Solidity fundamentals (types, fu structures, source code layout), and the creation and implementation of smart contracts.	for blockchain:			
	Basics of Cryptography and Hyperledger	(10 Hours)			
Design objectives, modular design, privacy, scalability, deterministic transactions, identity and audinteroperability, membership services, blockchain services, consensus mechanisms, and Hyp architecture Corda's Sawtooth Lake. Key generation, secure hash algorithms, hash pointers signatures, Merkle trees, Patricia trees, distributed hash tables, symmetric and public key crypto and cryptographic hard problems are examples of cryptographic primitives for blockchain.					
Cryptocurrencies, Applications, Use Cases and Challenges					
	Basics of Bitcoin and cryptocurrencies, digital keys and addresses, private/public key	s, Base58Check			

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

Prop ML grow Seeded

Integrated B.Tech. (Artificial Intelligence) and M.Tech. (Artificial Intelligence)

encoding, multi-signature addresses, block structure, mining, proof of work, Bitcoin network, payments, clients, and APIs. Blockchain applications in IoT, supply chain, government, finance, and security. Block size increases, sidechains, privacy issues, zero-knowledge proofs, homomorphic encryption, state channels, private transactions, scalability issues, and decentralized applications (DApps).

(Total Contact Time= 45 Hours)

#### 4. Books Recommended:

- 1. Imran Bashir, "Mastering Blockchain", 2/E, Packt publishing, Mumbai, 2018.
- 2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", 2/E, O'Reilly, 2014.
- 3. Melanie Swan, "Blockchain Blueprint for a New Economy", 1/E, O'Reilly Media, 2015.
- Don and Alex Tapscott, "Blockchain Revolution", 1/E, Penguin Books Ltd, 2018
- Alan T. Norman, "Blockchain Technology Explained", 1/E, CreateSpace Independent Publishing Platform, 2017.

low PMJ

Quell

Special

Speci

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)



IPG IV (AI) Semester – VIII SOCIAL NETWORK ANALYSIS		L	Т	Р	Credit
IA460	Scheme	3	0	0	03

1. (	Course Outcomes (COs):
At the	end of the course, students will be able to
CO1	Conceptualize and represent social phenomena as networks.
CO2	Calculate and interpret key network metrics.
CO3	Apply different methods for collecting and managing network data.
CO4	Visualize and interpret network structures.
CO5	Critically evaluate and apply social network analysis to address real-world problems.

2.	Syllabus	
	Introduction	(08 Hours)
	Definition of Social Network Analysis (SNA), History and Key Figures in SNA,	The Relational
	Perspective, Applications of SNA in Various Fields, Basic Network Concepts: Types of Networks (Directed/Undirected, Weighted/Unweighted, Multiplex)	Nodes, Edges,
	Representing Networks	(05 Hours)
	Adjacency Matrices and Edge Lists, Graph Representation, Ontology-bas	
	Representation, Ontology languages for the Semantic Web: Resource Description Web Ontology Language, Ontological representation of social relationships — A reasoning with social network data	
	Web Ontology Language, Ontological representation of social relationships - A	ggregating and
	Web Ontology Language, Ontological representation of social relationships — A reasoning with social network data	ggregating and (07 Hours)
	Web Ontology Language,Ontological representation of social relationships — A reasoning with social network data  Node-Level and Dyad-Level Metrics	(07 Hours) ess Centrality,
	Web Ontology Language,Ontological representation of social relationships — A reasoning with social network data  Node-Level and Dyad-Level Metrics  Degree Centrality (In-degree, Out-degree), Betweenness Centrality, Closen-Eigenvector Centrality and PageRank, Reciprocity, Transitivity and Triadic Closen	(07 Hours) ess Centrality,
	Web Ontology Language,Ontological representation of social relationships — A reasoning with social network data  Node-Level and Dyad-Level Metrics  Degree Centrality (In-degree, Out-degree), Betweenness Centrality, Closen Eigenvector Centrality and PageRank, Reciprocity, Transitivity and Triadic Clustering Coefficient, Components and Connectedness	(07 Hours) ess Centrality, osure, Density, (07 Hours) ty Optimization,

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In D MA Prount Loopse

Layout Algorithms (Force-Directed, Circular, etc.), Node and Edge Attributes for Visualization, Communicating Network Insights Visually, Best Practices in Network Visualization, Surveys and
Questionnaires, Archival Data and Records, Online Data and Digital Trace Data, Ethical
Considerations in Network Data Collection
Network Models (05 Hours)
Random Graph Models (Erdos-Renyi), Small-World Networks (Watts-Strogatz), Scale-Free
Networks (Barabasi-Albert), Stochastic Actor-Based Models (SABMs) - Introduction, Exponential
Random Graph Models (ERGMs) - Introduction
Social Media Analysis (06 Hours)
Analyzing Online Social Networks (Twitter, Facebook, etc.), Sentiment Analysis in Networks, Information Spread and Misinformation, Ethical Considerations in Online Network Research, Graph Neural Networks, Graph Convolutional Neural Network with Attention
(Total Contact Time: 45 Hours)

#### 3. Books Recommended:

- 1. Social Network Analysis by Tanmoy Chakraborty, Wiley, 2021
- 2. Network Science by Albert-Lazzlo Barabasi
- 3. Social Network Analysis: Methods and Applications by Stanley Wasserman, Katherine Faus
- 4. Social Network Analysis by John G. Scott
- 5. Social Network Analysis: Methods and Examples by Song Yang, Franziska B Keller, Lu Zheng

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit 0 (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

In D My preum Jagged.

IPG IV (AI) Semester-VIII			_	D	C al!4
Agentic AI		L		Р	Credit
IA462	Scheme	3	0	0	3

1. (	Course Outcomes (COs):	
At the	e end of the course, students will be able to	
CO1	Understand the foundational concepts of AI and agentic systems.	
CO2	Develop skills to design, implement, and evaluate Al agents.	
CO3	Explore real-world applications of AI in various domains.	
CO4	Discuss ethical, societal, and economic implications of AI technologies.	
CO5	Be prepared for research, innovation, or industry roles in AI and agentic systems.	

2.	Syllabus		
	Foundations of AI Agents and Agentic AI	(07 Hours)	
	Definitions and distinctions: Al agents vs. Agentic Al, Core components of Al agents: percept making, action, Types of Al agents: reactive, deliberative, hybrid, Introduction to Agentic Al autonomy, goal-orientation, adaptability, Ethical considerations in Al agent development.	tion, decision- principles:	
	Large Language Models (LLMs) and Agent Integration	(08 Hours)	
	LLM fundamentals: architecture, capabilities, limitations. Prompt engineering: techniques f interaction, Function calling: enabling LLMs to interact with external tools, Retrice Generation (RAG) for enhanced agent knowledge,		
	Multi-Agent Systems and Collaborative Al	(06 Hours)	
	Multi-agent system architectures, Agent communication and coordination, Coordination, co competition in MAS. Workflow orchestration with multiple agents, Tools like AutoGen and Coordination.		
	Advanced Agentic AI Architectures and Patterns	(08 Hours)	
	gentic AI design patterns: ReAct, planning, reflection, Agent memory and state management, Agentic RAC ystems, LangGraph, Meta-learning and few-shot learning for adaptive agents.		
	Al Agent Development Frameworks and XAI	(07 Hours)	
	Tools and frameworks for building AI agents: OpenAI Gym, Unity ML-Agents, and R environments for training and testing agents, Techniques for making AI agents to interpretable (SHAP, LIME, and saliency maps), Ethical implications of explainability in AI systems.	transparent and	

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: O1 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)

Curriculum SVNIT Surat (58th Senate, 31 May 2023)

by P M how have

Al Agents in Real-World Applications	(09 Hours)
Applications of AI agents in robotics, healthcare, finance, autonomous systems, virtual customer service agents.	assistants and
(Total Contact Time: 45 Ho	urs = 45 Hours )

#### 3. Books Recommended:

- 1. Artificial Intelligence: A Modern Approach by Stuart Russell and Peter Norvig.
- 2. Multi-Agent Systems: An Introduction to Distributed Artificial Intelligence by Jacques Ferber.
- 3. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations" by Yoav Shoham and Kevin Leyton-Brown.
- 4. An Introduction to MultiAgent Systems" by Michael Wooldridge
- 5. Research papers from top AI conferences: CVPR, NeurIPS, ICML, AAAI, and IJCAI.

Year, XX: Subject Sequence number XX: last digit O
ers, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN for Minor au

Subject Code: ##nXX; ##: Department Identity, n: Year, XX: Subject Sequence number XX: last digit O (subject offered in both ODD and EVEN semesters, XX: 01 to 30 – last digit ODD and EVEN for ODD and EVEN semesters (Mandatory Core), XX: 31 to 50 (Optional Core), XX: 51 to 99 (Elective), Subjects list for Minor and Honor (M/H#1-4), Subjects list for Specialization track (#1-4) EG: Engineering Subject, SC: Science Subject (offered combinedly by departments) (SVNIT Surat)