



**MANIPAL UNIVERSITY
JAIPUR**

Manipal University Jaipur

Department of Information Technology

Academic Booklet

Program Name	B.Tech (Information Technology)
Program Code	INT
Number of Credits	160
Duration	4 Years
Batch	2023 - 2027



Four Year Course/Program Structure

Year	Semester	Course Structure						
I	I (Chemistry Cycle)	S.No	Course#	Course Name	L	T	P	C
		1	CY1001	Engineering Chemistry	2	1	2	4
		2	MA1001	Calculus and Matrices	2	1	0	3
		3	EE1002	Electrical and Electronics Systems	3	1	0	4
		4	ME1007	Creativity and Innovation	1	1	0	2
		5	CS1002	Problem Solving Using Computers	2	1	0	3
		6	ME1035	Engineering Graphics Lab	0	0	2	1
		7	LN1001	Technical Writing Clinic 1	1	1	0	1
		8	EC1030	Electrical and Electronics Lab	0	0	2	1
		9	CS1031	Problem Solving Using Computers Lab	0	0	2	1
		Total			11	6	8	20
	II (Physics Cycle)	S.No	Course#	Course Name	L	T	P	C
		1	PY1001	Engineering Physics	2	1	2	4
		2	MA1002	Computational Mathematics	2	1	0	3
		3	CY1002	Environmental Studies	2	0	0	2
		4	CV1201	Engineering Materials and Mechanics	3	1	0	4
		5	ME1006	MatLab for Engineers	2	0	0	2
		6	BI1001	Biology for Engineers	2	0	0	2
		7	LA1010	Constitution of India	1	0	0	1
		8	MC1030	IoT Fab Lab	0	0	2	1
		9	DA1001	Universal Human Values	1	0	0	1
		Total			15	3	4	20
II	III	S.No	Course#	Course Name	L	T	P	C
		1	MEE2001	Engineering Economics	3	0	0	3
		2	MBB2101	Management of Technology	3	0	0	3
		3	INT2101	Computer System Architecture	3	1	0	4
		4	INT2102	Data Structures and Algorithms	3	1	0	4
		5	INT2103	Relational Database Management Systems	3	1	0	4
		6	INT2120/INT2121	C++ Programming / Python Programming	3	1	0	4
		7	INT2130	Data Structures and Algorithms Lab	0	0	2	1
		8	INT2131	Relational Database Management Systems Lab	0	0	2	1
		9	INT2170	Project Based Learning 1	0	0	2	1
		Total			18	4	6	25
	IV	S.No	Course#	Course Name	L	T	P	C
		1	MAS2001	Statistics and Probability	3	0	0	3
		2	INT2201	Operating Systems	3	1	0	4
		3	INT2202	Object-Oriented Programming	3	1	0	4
		4	INT2220/INT2221	Data Communications / Modern Web Technologies	3	1	0	4
		5	INT22XX	Program Elective 1	3	0	0	3
		6	INT2230	Operating Systems Lab	0	0	2	1
		7	INT2231	Object-Oriented Programming Lab	0	0	2	1
		8	INT2270	Project Based Learning 1	0	0	2	1
		9	XXXXXX	Open Elective 1	3	0	0	3
		Total			18	3	6	24
III	V	S.No	Course#	Course Name	L	T	P	C
		1	INT3101	Design and Analysis of Algorithms	3	1	0	4
		2	INT3102	Software Engineering	3	1	0	4
		3	INT3120/INT3121	Artificial Intelligence / Theory of Computation	3	1	0	4
		4	INT31XX	Program Elective 2	3	0	0	3
		5	INT31XX	Program Elective 3	3	0	0	3
		6	INT3130	Design and Analysis of Algorithms Lab	0	0	2	1
		7	INT3131	Software Engineering Lab	0	0	2	1
		8	INT3170	Project Based Learning 3	0	0	2	1
		9	XXXXXX	Open Elective 2	3	0	0	3
		Total			18	3	6	24
	VI	S.No	Course#	Course Name	L	T	P	C
		1	INT3201	Computer Networks	3	1	0	4
		2	INT32XX	Program Elective 4	3	0	0	3
		3	INT32XX	Program Elective 5	3	0	0	3
		4	INT32XX	Program Elective 6	3	0	0	3
		5	INT3210	Professional Practice	0	0	0	1
		6	INT3230	Computer Network Lab	0	0	2	1
		7	INT3231/INT3232	Machine Learning Lab / Compiler Design Lab	0	0	2	1
		8	INT3270	Project Based Learning 4	0	0	6	3
		9	XXXXXX	Open Elective 3	3	0	0	3
		Total			15	1	10	22
IV	VII	S.No	Course#	Course Name	L	T	P	C



		1	INT41XX	Program Elective 7	3	0	0	3
		2	INT41XX	Program Elective 8	3	0	0	3
		3	INT4170	Internship (Industry / Research)	0	0	0	1
		4	XXXXXX	Open Elective 4	3	0	0	3
		5	XXXXXX	Open Elective 5	3	0	0	3
		Total			12	0	0	13
	VIII	S.No	Course#	Course Name	L	T	P	C
		1	INT4270	Major Project	0	0	0	12
		Total			0	0	0	12

List of Core Courses / Program Electives / Flexi Core Course / Open Electives

Core Courses Total : 08	1. INT2101 Computer System Architecture [3 1 0 4] 2. INT2102 Data Structures and Algorithms [3 1 0 4] 3. INT2103 Relational Database Management Systems [3 1 0 4] 4. INT2201 Operating Systems 5. INT2202 Object-Oriented Programming 6. INT3101 Design and Analysis of Algorithms 7. INT3102 Software Engineering 8. INT3201 Computer Networks		
Flexi Core Courses Total : 03	Flexible Core Course 1 Choices: 1. INT2120 C++ Programming 2. INT2121 Python Programming	Flexible Core Course 2 Choices: 1. INT2220 Data Communications 2. INT2221 Modern Web Technologies	Flexible Core Course 3 Choices: 1. INT3120 Artificial Intelligence 2. INT3121 Theory of Computation
Program Electives Total : 08	Program Elective 1 Choices 1. INT2240 Computer Organization and Microprocessor 2. INT2241 IoT Fundamentals	Program Elective 2 Choices 1. INT3140 Advanced Java 2. INT3141 Soft Computing Techniques	Program Elective 3 Choices 1. INT3142 Foundations of Data Science 2. INT3143 Distributed Computing 3. INT3144 Cryptography and Network Security
	Program Elective 4 Choices 1. INT3240 Data Analytics Using Python 2. INT3241 Cloud Infrastructures and Services 3. INT3242 Secure Programming	Program Elective 5 Choices 1. INT3243 Data Warehousing and Mining 2. INT3244 Cloud Computing and Virtualization 3. INT3245 Vulnerability Assessment and Ethical Hacking	Program Elective 6 Choices 1. INT3246 Compiler Design 2. INT3247 Machine Learning Techniques
	Program Elective 7 Choices 1. INT4140 Big Data Analytics 2. INT4141 Cloud Application Development 3. INT4142 Block Chain Technologies	Program Elective 8 Choices 1. INT4143 Deep Learning 2. INT4144 Software Testing Techniques 3. INT4145 Natural Language Processing 4. INT4146 Image Processing 5. INT4147 Quantum Computing	
Open Electives (Not for Any Computing Stream Students) Total: 09	1. INT0050 Java Programming Basics 2. INT0051 Introduction to AI 3. INT0052 Linux Fundamentals 4. INT0053 Basics of Cloud Computing 5. INT0054 Python Basics 6. INT0055 Introduction to Data Analytics 7. INT0056 Basics of Computer Networks 8. INT0057 Introduction to Data Structures 9. INT0060 Python for Data Analytics [Offered only for Integrated MBA Program]		

Detailed Course Syllabus

First Year B.Tech (Common to all branches)

CHEMISTRY CYCLE						PHYSICS CYCLE					
Code	Course Name	L	T	P	C	Code	Course Name	L	T	P	C
CHY1001	Engineering Chemistry	2	1	2	4	PHY1001	Engineering Physics	2	1	2	4
MAS1001*	Calculus & Matrices*	2	1	0	3	MAS1002*	Computational Mathematics*	2	1	0	3
EEE1002	Electrical & Electronics Systems	3	1	0	4	CHY1002	Environmental Studies	2	0	0	2
MEE1007	Creativity & Innovation	1	1	0	2	CIV1001	Engineering Materials & Mechanics	3	1	0	4
CSE1002	Problem Solving Using Computers	2	1	0	3	MEE1006	MATLAB for Engineers	2	0	0	2
MEE1035	Engineering Graphics Lab	0	0	2	1	BIT1001	Biology for Engineers	2	0	0	2
LLC1001	Technical Writing Clinic 1	0	0	2	1	LAS1010	Constitution of India	1	0	0	1
EEE1030	Electrical & Electronics Lab	0	0	2	1	MCE1030	IoT Fab Lab	0	0	2	1
	Math Bridge for BioTech*					DOA1001	Universal Human Values	1	0	0	1
CSE1031	Problem Solving Using Computers Lab	0	0	2	1						
		10	5	10	20			15	3	4	20
Total Contact Hours (L+T+P)		25				Total Contact Hours (L+T+P)		22			

- * “Math Bridge for BioTech” is a value Added course (VAC) for the students having taken admission in B.Tech in BioTechnology.
- * “Applied Mathematics I” (MAS1109) [3 0 0 3] course only for B.Tech in BioTechnology students in the Chemistry Cycle in place of MAS1001.
- * “Applied Mathematics II” (MAS1210) [3 0 0 3] course only for B.Tech in BioTechnology students in the Physics Cycle in place of MAS1002.

CHEMISTRY CYCLE

CHY1001: Engineering Chemistry [2 1 2 4]

Classification of Fuels, Gross Calorific value and Net Calorific value. Solid, Liquid and Gaseous fuels. Concept of corrosion and its importance, types of corrosion, factors affecting corrosion, Corrosion control methods. Chemistry of primary and secondary batteries. Working principles of fuels cells and their applications. Water treatment technology. Theory and application phase rule (up to two component system). Advanced materials and polymers: ceramics, semiconductors, conducting polymers, composites, bio-materials, nanomaterials, and their properties and applications. Experiential learning on chemistry-Chemical Fuel: Determination of coefficient of viscosity of liquid; Determination cloud and pour point of a given sample of lubricating oil using cloud and pour point apparatus; Determine the water equivalent of bomb calorimeter using benzoic acid as fuel. Corrosion: Redox titrations for electrochemistry Water Treatment: Determination of hardness of water and ion exchange method, pH-metric titration; Conductometric acid base titrations Polymer and advanced material: Synthesis of polymer and advanced materials

References:

1. Jain P.C. and Jain M., Engineering Chemistry, Dhanpat Rai and Sons, Delhi, Revised, 15th Edn. 2006.
2. Engineering chemistry, Wiley India Pvt. Ltd., 2018.
3. Kuriacose J.C., Raja R. J., Chemistry in Engineering and Technology, Vol. I/II TMH 1988.
4. Fischer T., Materials Science for Engineering Students, Academic Press, London, 2009.
5. Fuel Science & Technology Hand Book, James G Speight; Marcel Dekker, New York.
6. <https://nptel.ac.in/courses/122/101/122101001/#>

MAS1001: Calculus and Matrices [2 1 0 3]

Differential calculus: Curvatures, Asymptotes; Partial differentiation, total derivatives, Taylor's theorem, maxima and minima, Lagrange's method. Integral Calculus: Double and Triple integrals, Change of the order of integration. Change of variables. Applications of Multiple integrals. Vector Calculus: Differentiation of vectors and their physical meaning. Line and surface integrals. Matrix Algebra: Rank, Inverse of a matrix, and solution of linear simultaneous equations. Eigenvalues and Eigenvectors of a matrix, Cayley-Hamilton theorem.

References:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K. 2011.
2. R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House. 2005.
3. M.D. Weir, J. Hass, F.R. Giordano, Thomas' Calculus, 11th Edition, Pearson Education. 2008.

EEE1002: Electrical & Electronics Systems [3 1 0 4]

Overview of Electrical System: Renewable and conventional energy sources, Transmission & Distribution Systems, Electrical Loads- Classification, types & characteristics. Electrical system for residential/industrial installations. DC and AC Circuits and Analysis: Mesh and Nodal analysis methods, Superposition theorem, Thevenin's theorem, and Maximum power transfer theorem. AC Circuits - Phasor representation, single-phase and 3-phase circuits. Measurement Systems and Instrumentation: Transducer characteristics, strain gauges, accelerometers, displacement sensor, pressure transducers, and temperature sensors. Signal acquisition - A/D converters. Fundamental of Electric Vehicles: Types of EVs, Constructional aspects, Hybrid EV Configurations, EV Battery, and Electric Motors. Semiconductors devices: PN Junction diode - construction, biasing, equation and its I-V characteristics, wave-shaping circuits, BJT: Operation and DC Biasing analysis. Introduction to Operational Amplifier. Digital System Design: Boolean algebra, De Morgan's Theorem, K-map for minimization of Boolean expressions, Adder and Subtractor, Introduction to Encoders, Decoders, Multiplexer, Demultiplexer. Introduction to Modern Electronic Systems: Introduction, block diagram, components, and operation of 5G, Drone Technology, IoT and 3-D Printers.

References

1. T.K. Nagasarkar and M.S. Sukhija. Basic Electrical Engineering (3e), Oxford University Press, 2017.
2. D.C. Kulshreshtha. Basic Electrical Engineering (2e), McGraw Hill Education India, 2019.
3. D.P. Kothari and I.J. Nagrath, Basic Electrical and Electronics Engineering, McGraw Hill Education India, 2014.
4. D.P. Kothari, K.C. Singal, and R. Ranjan, Renewable Energy Sources and Emerging Technologies (3e), PHI, 2022.
5. H.S. Kalsi, Electronic Instrumentation (4e), McGraw Hill Education India, 2019.
6. R.L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory (10e), Pearson, 2009.
7. R.A. Gayakwad Op-Amps and linear Integrated Circuit (4e), PHI.
8. S. Salivahanan and S. Arivazhagan. Digital circuits and Design (5e), Oxford University Press, 2018.

MEE1007: Creativity & Innovation [1 1 0 2]

What is creativity? Brain networks associated with creativity. Divergent thinking and innovation; Need of innovation: types of innovation; What type of innovation is needed in india? Innovation in solving problems, data analysis, automation & innovation, idea generation, design thinking, idea convergence and divergence, focused problems, prototype development, implementation of idea. Innovation in Indian and global context; automation, convergence of ideas, Innovation management; importance, difference with creativity, invention and discovery. Case studies in on business ideas on established startups. Economic aspects; venture capital, angel investors, Evaluation of effectiveness of innovation; Legal aspects: IPR. Prototyping; ability to materialize concepts and ideas through modeling and “Rapid prototype”, Communicating ideas trough visual maps and three-dimensional representations. Implementation; Controlling and combining multiple variables of a problem, Detecting the key proposals and synthesizing them in a final solution, Creating a system around the solution and developing a value proposition. Lean Canvas features and applications.

References:

1. Tom Kelley and David Kelley, Creative Confidence: Unleashing the creative potential within us all, William Collins, 2013
2. Vinnie Jauhari & Sudhanshu Bhushan, “Innovation Management” Oxford University Press 2014.
3. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2004
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003.
5. P. N. Rastogi, Managing Creativity for Corporate Excellence, Macmillan 2009.

CSE1002: Problem Solving Using Computers[2 1 0 3]

Digital computer fundamentals: Algorithms and flowcharts, the von Neumann architecture, programs, assembly language, high level programming languages; Imperative programming (Using C): data types, variables, Storage Classes, enumerated data types, operators, expressions, statements, control structures, functions, arrays and pointers, recursion, records (structures), files, input/output, some standard library functions and some elementary data structures.

References:

1. E. Balagurusamy, Programming in ANSI C, 8th Edition, McGraw Hill Publication, 2019.
2. Y. P. Kanetkar, Let us C, 19th Edition, BPB Publication, 2022.
3. B. W. Kernighan, D. M. Ritchie, The C Programing Language, 2nd Edition, Prentice Hall of India, 2014.
4. B. Gottfried, Schaums Outline Series: Programming with C, 4th Edition, McGraw Hill Publication, 2018.

MEE1035: Engineering Graphics Lab [0 0 2 1]

Introduction to Engineering Graphics. Principle of Orthographic Projections Projection of Points located in different quadrants. Introduction to AutoCAD, Basic commands for 2D drawing. Projection of line with its inclination to the reference planes. Projections of planes with its inclination to the reference planes, Concept of auxiliary method for projections of the plane. Classification of solids, Projection of solids along with frustum with its inclination to one reference Plane.

References:

1. Computer Aided Engineering Drawing, K R Gopala Krishna and Sudheer Gopala Krishna, CBCS, 2015
2. Engineering Drawing and Graphics + AutoCAD, Venugopal, New Age International Publisher, 2009
3. Engineering Graphics, Basant Aggarwal & CM Aggarawal, McGraw Hill Publication, 2018.
4. Engineering Graphics with AUTO CAD, DM Kulkarni & AP Rastogi, PHI Learning Private Limited, 2010.
5. Engineering Graphics with AUTO CAD, TM Jeyapovan, Vikas Publishing House, 2015.

LLC1001: Technical Writing Clinic 1 [0 0 2 1]

Process & Types of Communication: Definition, Features, Modes & Barriers. Non-Verbal Communication: Types, Significance. Listening Skills: Listening, Hearing, Active Listening, Passive Listening. Speaking Skills: Making effective Presentations, Creating Power Point Presentations (PPTs), Presenting in Groups/Individually. Reading Skills: Reading Techniques, Skimming & Scanning, Comprehension & Precis Writing. Writing Skills: Basics of Resume Writing & Professional Social Media Profiling; Letter & Email Writing; Reviewing Research Papers, Blog Writing

References:

1. Meenakshi Raman and S. Sharma, Technical Communication: Principles and Practice, (2/e), Oxford University Press, 2013.
2. Ronald B. Adler, George Rodman and Athena du Pré, Understanding Human Communication, Oxford University Press, 2020.
3. Sanjay Kumar and Pushplata, Communication Skills, Oxford University Press, 2016.
4. Sunita Mishra and C. Muralikrishna, Communication Skills for Engineers, Pearson, 2014.

EEE1030: Electrical & Electronics Lab [1 0 2 1]

Familiarization of different electrical and electronics components and instruments. Electrical System: Residential/ industrial installations, understanding different electrical machines using cut-section models, P-V and I-V characteristics of Solar PV system. Measurement Systems: Virtual instrumentation using LABVIEW, real-time data acquisition, voltage measurement, temperature measurement. Electrical Vehicle: basic design of electric vehicle using BLDC motors. Electronic Devices and Circuits: VI characteristics of diode, BJT, and MOSFET. Inverting and non-inverting amplifier using op-amp. Digital Circuits: Verification and/or implementation of various digital circuits. Semiconductor fabrication process and computerized PCB design.

References:

1. D.P. Kothari and I.J. Nagrath, Basic Electrical and Electronics Engineering, McGraw Hill Education India, 2014.
2. D.P. Kothari, K.C. Singal, and R. Ranjan, Renewable Energy Sources and Emerging Technologies (3e), PHI, 2022.
3. H.S. Kalsi, Electronic Instrumentation (4e), McGraw Hill Education India, 2019.
4. R.L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory (10e), Pearson, 2009.
5. R.A. Gayakwad Op-Amps and linear Integrated Circuit (4e), PHI.

CSE1031: Problem Solving Using Computers Lab [0 0 2 1]

Digital computer fundamentals: Algorithms and flowcharts, the von Neumann architecture, programs, assembly language, high level programming languages; Imperative programming (Using C): data types, variables, Storage Classes, enumerated data types, operators, expressions, statements, control structures, functions, arrays and

pointers, recursion, records (structures), files, input/output, some standard library functions and some elementary data structures.

References:

1. E. Balagurusamy, *Programming in ANSI C*, 8th Edition, McGraw Hill Publication, 2019.
2. Y. P. Kanetkar, *Let us C*, 19th Edition, BPB Publication, 2022.
3. B. W. Kernighan, D. M. Ritchie, *The C Programming Language*, 2nd Edition, Prentice Hall of India, 2014.
4. B. Gottfried, *Schaums Outline Series: Programming with C*, 4th Edition, McGraw Hill Publication, 2018.

Math Bridge for BioTech

Set, Relation and Functions - Set Theory: Definition and Representation, Types of Sets, Operations on Sets. Relations: Definition, types of Relations. Functions: Definition, Classification, Domain and Range, Types of Functions. Matrices and Determinants: Concept and Definition of Matrix, Types of Matrices, Operations on matrices, Determinant of a matrix, Inverse of a square matrix, Properties of Matrices and Determinants. Differential and Integral Calculus: Differentiability, Derivatives of some elementary functions, product and quotient rules, chain rule, Limits and continuity, Indefinite integral, Definite integral. Differential equations: Introduction to ordinary and partial differential equations. Solutions to first order differential equations, Exact differential equations, integrating factor, and inspection method. Probability: Counting principle, Permutation and Combination, Concept of Probability, Trial and Events, Sample space, Types of events, Classical and Axiomatic definition of Probability, Additive and Multiplicative Law, Conditional Probability. Trigonometry and Vector Algebra - Trigonometry: Angles - Measurements - Degrees - Radians - Quadrants - Trigonometric ratios - Ratios of particular angles, Representation of vectors, types of vectors, operation on vectors, direction ratios and direction cosines.

References:

1. Mathematics Textbooks of Class IX, NCERT, 2022
2. Mathematics Textbooks of Class XII, NCERT, 2022
3. AICTE module for bridge course in Mathematics, 2022
4. <https://www.aicte-india.org/sites/default/files/final%20maths.pdf>

PHYSICS CYCLE

PHY1001: Engineering Physics [2 1 2 4]

Double slit interference, coherence, intensity in double slit interference, thin film interference, Newton's rings, diffraction and wave theory of light, single-slit diffraction, intensity in single-slit diffraction (using phasor method), diffraction at a circular aperture, double-slit interference and diffraction, combined-intensity in double-slit diffraction (qualitative approach), diffraction of light through multiples slits, diffraction gratings, polarization of electromagnetic waves, polarizing sheets, polarization by reflection, Black body radiation and Planck's hypothesis, Stefan's Law, Wein's displacement law, Photoelectric effect, Compton effect, photons and electromagnetic waves, wave properties of particles, de Broglie hypothesis, Davisson-Germer experiment, quantum particle (wave packet, phase velocity, group velocity), the uncertainty principle. An interpretation of quantum mechanics, wave function and its significance, Schrödinger equation, particle in a box, particle in a well of finite height (qualitative), Tunneling through a potential barrier and its applications, X-ray spectrum, Moseley's law, spontaneous and stimulated transitions, metastable states, population inversion, laser system, Free electron theory, Fermi level, Density of states, Electron in a Periodic potential-Bloch's theorem, Kronig- Penny Model (Qualitative Treatment), origin of Energy Band Formation in Solids, Classification of Materials into Conductors, Semi-Conductors & Insulators, Effective mass of an Electron. Experiments on interference, diffraction (single slit and grating), polarization, ultrasonic waves, quantum physics (photo electric effect, Black body radiation, tunneling in Zener diode) and electronic materials (energy band gap, Hall-effect).

References:

1. Halliday D., Resnick R., Krane K. S., *Physics* (5e), Wiley, 2016.
2. Beiser A., Mahajan S., Rai Chaudhary S., *Concepts of Modern Physics*, (7e), McGraw Hill Education, 2017.
3. Serway R. A., Jewett J. W., *Physics for Scientists and Engineers with Modern Physics*, Thomson, 2013.

MAS1002: Computational Mathematics [2 1 0 3]

Numerical Methods: Finite difference and interpolation for equal and unequal intervals, Numerical differentiation and integration. Solution of algebraic and transcendental equations, solutions of ordinary differential equations. Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism of graphs, Euler and Hamiltonian paths, Graph coloring. Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences.

References:

1. Liu and Mohapatra, "Elements of Discrete Mathematics", McGraw Hill, 2018
2. Jean Paul Trembley, R Manohar, Discrete Mathematical Structures with Application to Computer Science, McGraw-Hill, 2019
3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, Addison Wesley, 2020
4. B. Kolman, R.C. Busby, and S.C. Ross, Discrete Mathematical Structures, PHI Learning Private Limited, Delhi India.
5. Numerical Methods: M.K. Jain, S.R.K. Iyenger and R.K. Jain, 2021
6. Sastry S. S., Introductory methods of Numerical analysis, (4e), PHI, 2007.

CHY1002: Environmental Studies [2 0 0 2]

Meaning, multidisciplinary nature of environmental science, applications in engineering disciplines, environmental ethics, sustainable development, Natural (renewable and non-renewable) resources, Resource consumption, Biodiversity and conservation methods, different types of energy, Conventional sources & Non- Conventional sources of energy, Types and Structure of Ecosystem, Environmental Pollution and control, Disaster Management meaning, natural disasters especially earthquakes & Manmade disasters, Environmental Engineering:- Water demand, Water quality standards, basics of water treatment, Conservation of water, Characteristics of sewage, treatment and disposal, Environmental crisis & legislations, Environmental acts, Laws and Policies, EIA, Case studies of the past related to environmental issues, crisis, disasters, hazard, pollution, climate change & its effects, Practical activity related to environmental problems and its impacts on environment.

References:

1. Rajagopalan, R., Environmental Studies: From Crisis to Cure, (2e), Oxford University Press, 2016.
2. De, A. K. and De, A. K., Environmental Studies (2e), New Age Publishers, New Delhi, 2009.
3. Bharucha E., Text book of Environmental Studies for undergraduate courses, (4e), Universities Press, Hyderabad, 2013.



CIV1201: Engineering Materials & Mechanics [3 1 0 4]

Working Fluid: Properties of steam, Steam tables, Steam Generators, Classification, Construction and working of Simple boiler. Laws of thermodynamics, Refrigeration and Air Conditioning: Definition, concept, Vapour Compression cycle, C.O.P., working principles and schematic diagrams of Refrigerator, Air Conditioner. Internal Combustion Engine: Classification, Otto and Diesel cycles, Construction and working of SI and CI engine, Two stroke and Four stroke engine, Calculation of thermal efficiency of cycles. Power Transmission: Classification and applications of mechanical drives like belts, ropes, chains and gear drives and their velocity ratios, length of belts, ratio of tensions in belts and ropes, gear train. Machine Tools: Construction, Working and specification of Lathe, Drilling machine and Milling machine. Foundry: Foundry tools and equipment's, Procedure for moulding. Welding: Definition, Gas and Arc welding, Soldering and Brazing. Forging: Definition, applications, tools, Different Forging operations.

References:

1. S.K.Duggal, Building Materials, New Age International Publisher, 2021.
2. S.C. Rangwala, Engineering Materials, Charotar Publication, 2017.
3. M. L. Gambhir and N. Jamwal, Building Materials Products, Properties and Systems, McGraw Hill Education, 2017.
4. S. Ramamrutham, Engineering Mechanics, Dhanpat Rai Publishing Company (P) Ltd, 2018
5. R. S. Khurmi, A Textbook of Engineering Mechanics, S Chand Publication, 2018.
6. S. Timoshenko, D. H. Young, J. V. Rao, Engineering Mechanics, McGraw Hill Education, 2017
7. R.C. Hibbeler, Engineering Mechanics: Principles of Static and Dynamics, Pearson India, 2017.

MEE1006: MATLAB for Engineers [2 0 0 2]

Introduction to MATLAB environment and commands, Interactive Computation, Matrices and Vectors, Matrix and Array Operations, Character strings, Command- Line Functions, Saving and Loading Data, Programming in MATLAB: Scripts and Functions, Curve Fitting, and Numerical Techniques, Solving Equations (ODE and IDE), Computer Algebra and The Symbolic Math Toolbox, Using MATLAB for Simple engineering problems. Engineering Applications: Introduction to MATLAB SIMULINK and examples, MATLAB Toolboxes: Signal Processing Toolbox, Image Processing Toolbox, Statistics and Machine Learning Toolbox, Neural Network Toolbox, Control System Toolbox, Optimization Toolbox.

References:

1. Getting Started With MATLAB, Rudra Pratap, Oxford Press.
2. Stephen J. Chapman. MATLAB Programming for Engineers (6e), Cengage Learning, 2020. ISBN: 978- 0-357-03039-4.
3. Bansal R.K., Goel A.K., and Sharma M.K. MATLAB and Its Applications in Engineering (2e). Pearson 2016.
4. MATLAB An Introduction with Applications, Rao V Dukkupati, New Age International Publishers,
5. Gonzalez and Woods. Digital Image Processing Using MATLAB (4e), Pearson, 2018.

BIT1001: Biology for Engineers [2 0 0 2]

Biomolecules such as Carbohydrates, Nucleic acids, Proteins, Enzymes, and their applications. Human organ system and biodesign: Brain as a CPU system, Eye as a Camera system, Heart as a pump system, Lungs as purification system. Bioinspired materials: Echolocation (sonars), Photosynthesis (photovoltaic cells), bird flying (aircrafts), Lotus leaf effect (self-cleaning surfaces). Human Blood substitutes - hemoglobin-based oxygen carriers. Trends in Bioengineering: Bioprinting techniques and materials, 3D printing of ear, bone and skin, electrical tongue and electrical nose in food science, Bioimaging and Artificial Intelligence for disease diagnosis. Self-healing bio-concrete and bioremediation.

References:

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
4. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
5. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
6. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
7. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
8. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
9. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
10. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011.



LAW1010: Constitution of India [1 0 0 1]

Historical Background & Preamble, Constitutional Governance, Constitutionalism and Theory of Statehood, Constitutional Supremacy and Constitution as a Grundnorm, Organs of the State and their Governance (Legislature, Executive and Judiciary), Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Writ Petition and Public Interest Litigation, Landmark Judgements in India.

References:

1. N.Shukla, Constitution of India. Eastern Book Agency,2014.
2. P.Jain, Indian Constitutional Law, Lexis Nexis,2023.
3. D. Basu, Introduction to the Indian Constitution of India, (20th Ed.2009)
4. M. Seervai, Constitutional Law of India, Universal Law Publishing Co, Reprint 2013.
5. M.Bakshi, The Constitution of India, Universal Law Publishing Co.,2014

MCE1030: IoT Fab Lab [0 0 2 1]

Arduino - Introduction to Arduino and its different modules. Basic programming environment of Arduino. Interfacing of different sensors (IR, Ultrasonic and Temperature sensors) and actuators (Motors, LED/LCD, and Buzzer) with Arduino. Mini project using Arduino. Raspberry Pi (RPi)- Introduction, Interfacing different elements with RPi. 3D Printing - Introduction, (Interfacing of 3D Printer with CAD models), Hands on 3D printing.

References:

1. Simon Monk, 2015. The TAB Book of Arduino Projects, McGraw-Hill Education.
2. Simon Monk., 2016. Programming the Raspberry Pi: getting started with Python. McGraw-Hill Education.
3. Norris, Donald. The internet of things: Do-it-yourself at home projects for arduino, raspberry pi, and BeagleBone black. McGraw-Hill Education, 2015.
4. Scott Fitzgerald and Michael Shiloh, 2012. The Arduino Projects Book, Arduino.
5. France, Anna Kaziunas. Make: 3D printing: The essential guide to 3D printers. Maker Media, Inc.,2013.
6. Cline, L.S., 2017. 3D Printer Projects for Makerspaces. McGraw-Hill Education.

DOA1001: Universal Human Values [0 0 2 1]

Universal Human Value: Introductions, Sanskars-Educational, Aspirations and Concerns, Self-Management, Health, Trust, Relationships, Harmony, society and nature, Need for a holistic perspective and way of living, Right Understanding (Knowing)-Knower, Known & the Process.

References:

- 1.R R Gaur, R Asthana, G P Bagaria, (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi, 2019.
2. Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.



Detailed Course Syllabus

Year: II, Semester: 03

S.No	Course#	Course Name	L	T	P	C
1	MEE2001	Engineering Economics	3	0	0	3
2	MBB2101	Management of Technology	3	0	0	3
3	INT2101	Computer System Architecture	3	1	0	4
4	INT2102	Data Structures and Algorithms	3	1	0	4
5	INT2103	Relational Database Management Systems	3	1	0	4
6	INT2120/INT2121	C++ Programming / Python Programming	3	1	0	4
7	INT2130	Data Structures and Algorithms Lab	0	0	2	1
8	INT2131	Relational Database Management Systems Lab	0	0	2	1
9	INT2170	Project Based Learning 1	0	0	2	1
Total			18	4	6	25

Choices for Flexible Core 1:

1. INT2120 C++ Programming
2. INT2121 Python Programming



MEE2001 Engineering Economics [3 0 0 3]
Syllabus
Concept and Value Analysis, Economic Decision Making, Types of Estimates, Accounting and Control, Elements of Cost, Prime Cost, Overheads, Types of Cost, Process Cost & Cost of Production, Break Even Analysis, Inventory Control & Management, EOQ, Financial Analysis, Simple payback, Return on Investment, NPV (Net Present Value), IRR (Internal rate of Return), Life Cycle Cost Method, Sensitivity Analysis, Project Financing Options. Budget and Budgetary Control, Concept of Budgeting, Type of Budgets. Risk - Risk vs Return, System Concept and Value Analysis, System Analysis & System Engineering, Value Analysis. Replacement Analysis, Depreciation, Network Analysis, Network Techniques, PERT (Programme evaluation and review technique), CPM (Critical Path Method)
Course Outcomes
• MEE2001.1: Describe various economic decision-making concepts and types of estimates. • MEE2001.2: Assess the financial viability of engineering projects. • MEE2001.3: Discuss budget and budgetary control concepts. • MEE2001.4: Analyse for replacement analysis and break-even analysis. • MEE2001.5: Estimate the projects for economic feasibility by risk analysis to enhance entrepreneurship skills.
Text and Reference Books
Text Book(s) 1. R. Panneerselvam, Engineering Economics, Prentice Hall of India. 2. J.L. Riggs, D.D. Bedworth and S.U. Randhawa, Engineering Economics, McGraw Hill Education. 3. P.L. Mehta, Managerial Economics, Sultan Chand & Sons. Reference Book(s) 1. E.L. Grant, W.G. Ireson and R.S. Leavenworth, Principles of Engineering Economic Analysis, John Wiley. 2. G.J. Tiesen, W.J. Fabrycky and H.G. Tiesen, Engineering Economy, Prentice Hall of India. L. Blank and A. Tarquin, Engineering Economy, McGraw Hill Education.

MBB2001 Management of Technology [3 0 0 3]
Syllabus
Invention and Innovation; Market analysis; Technology transition; Market survey technique; Analysing marketing opportunities; Ansoff Matrix; Project Formulations (1, 2 and 3) based on market survey technique; Commercialization; Financial Management; Human Resource Management; Leadership; Intellectual Property.
Course Outcomes
• MBB2001.1: Demonstrate the basic elements / requirements of becoming an entrepreneur, improving their business-skill. • MBB2001.2: Develop their engineering ideas into business model which may enhance the employability. • MBB2001.3: Plan the finances and human resources for the sustainable commercialization of new technologies. • MBB2001.4: Understand the importance of intellectual property rights while commercialising the innovative idea.
Text and Reference Books
• Innovation and Entrepreneurship by Drucker, P.F. Harper and Row Publications, 2006. • Business, Entrepreneurship and Management: Rao, V.S.P.; Vikas Publications, 2013. • Entrepreneurship: Theory, Process and Practice, Donald F. Kuratko and Richard M. Hodgetts, Thomson Learning Publications, 2003 • Entrepreneurship, Roy, Rajeev, Oxford University Press, 2020.

INT2101 Computer System Architecture [3 1 0 4]
Syllabus
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess-3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and products of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization. COMBINATIONAL CIRCUIT DESIGN: - Design of Half and Full Adders, Half and Full Subtractors, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder. SYNCHRONOUS SEQUENTIAL CIRCUITS: Flip



flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. **RTL and Micro Operations:** Register Transfer, Bus and Memory Transfer, Logic Micro Operations, Shift Micro Operations. **Basic Computer Organization:** Complete Computer Description & Design of Basic Computer, Instruction Codes, Computer Instructions, Timing & Control, Instruction Cycles, Memory Reference Instructions, Input/output & Interrupts; Control Unit: Hardwired vs. Micro Programmed Control Unit, **Central Processing Unit:** General Register Organization, Stack Organization, Instruction Format, Data Transfer & Manipulation, Program Control, RISC, CISC; **Computer Arithmetic:** Addition & Subtraction with sign-magnitude and 2's complement data, Multiplication Algorithms, Division Algorithms, Floating point arithmetic algo.

Course Outcomes

- INT2101.1: Understand the principles and basics of a computer system, interconnection among its functional units.
- INT2101.2: Design the functional and sequential circuits of computer system.
- INT2101.3: Understand and apply microoperation and instructions in computer arithmetic circuit.
- INT2101.4: Illustrate the different instructions and their formats.

Text and Reference Books

Text Book(s):

1. C. Hamacher, Z. Vranesic, Computer Organization, (6e), Tata McGraw Hill, 2016.
2. Hayes, J. P., Computer Architecture and Organization, (3e Revised), Tata McGraw Hill, 2017.
3. Hennessy, J.L., Patterson, D.A., and Goldberg, D., Computer Architecture a Quantitative Approach, (6e), Pearson Education Asia, 2017.

Reference Book(s):

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson
2. M. Morris Mano, "Computer System Architecture", Pearson, 3rd Edition Revised, 2017.
3. W. Stallings, "Computer Organization and Architecture –Designing for Performance", PHI, 2009.

INT2102 Data Structures and Algorithms [3 1 0 4]

Syllabus

Introduction: Algorithm Specification; **Performance Analysis:** Time and Space Complexity, Asymptotic Notation; **C Concepts:** Pointers, Functions, Arrays, Passing Arrays to Functions through Pointers, Dynamic Memory Allocation, Bubble Sort, Insertion Sort, Selection Sort, Structures, Arrays of Structures, Passing Structures to Functions; **List:** ADT, Array and its Types, Implementation, Operations, Linked List and its Types, Implementation and Operations; **Stack:** ADT, Implementations using Array and Linked List, Operations and its Applications; **Queue:** ADT, Implementations using Array and Linked List, Operations and its Applications; **Tree:** Terminologies, Different Types, Representation of Binary Tree using Array and Linked Structure, Binary Search Tree, Different Operations (Recursive and Non-Recursive), Heap, Heap Sort, Priority Queue, AVL Trees, B-Tree; **Graph:** Introduction, Representation, Operations and Applications; **Searching Techniques And Hashing.**

Course Outcomes

- INT2102.1: Understand the performance analysis of algorithms with their applications.
- INT2102.2: Illustrate basic concept of data structure operations such as traversing, insertion, deletion, searching and sorting.
- INT2102.3: Describe arrays, linked lists, stacks, queues, trees, and graphs are their representation in memory.
- INT2102.4: Perform various operations on different data structures and to solve real time problems.
- INT2102.5: Analyse and compare various searching and sorting algorithms, and assess the trade-offs involved in the design choices to develop employability skills.

Text and Reference Books

Text Book(s):

1. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, "Data Structures using C", Pearson Education, 2013.

Reference Book(s):

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", University Press (India) Pvt. Ltd., 2014.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2012.



3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “ Introduction to algorithms”, PHI, Fourth Edition, 2022.
4. Seymour Lipschutz, “Data Structures with C (Schaum's Outline Series)”, McGraw Hill Education Private Limited, 2011.
5. Mark Allen Weiss, “Data structures and Algorithm Analysis in C”, Pearson, Second edition, 2014.

INT2103 Relational Database Management Systems [3 1 0 4]

Syllabus

Introduction: DBMS Concepts, Database System Vs File System, Data Models, Schema & Instance, Schema architecture, Data independence, Data Base Languages and interfaces, Database system applications, Database users, Functions of DBA

Data Modeling using the Entity Relationship Model: ER model concepts, Entities, Attributes, Relationship & types, Relationship Constraints, Extended ER-Model Concept - Generalization, Specialization and Aggregation, Transforming ER diagram into the tables.

Relational Data models: Domains, Tuples, Attributes, Relations, Characteristics of relations, Keys, Key attributes of relation, Relational database, Schemas, Integrity constraints. Referential integrity, Relational Algebra and Relational Calculus, Relational algebra operators – Unary, Binary, Set Operations. Tuple oriented and domain oriented relational calculus and its operations

SQL: Basic SQL Query, Creating Table and Views, SQL as DML, DDL and DCL, SQL Algebraic Operations, Joins, Sub-Queries, Aggregate Operations, Cursors, Dynamic SQL, Integrity Constraints in SQL, Triggers

Data Base Design: Introduction to Normalization, Functional dependency, Normal forms, Decomposition, Armstrong's Axioms, Canonical Cover, Lossless Join & Dependency preservation Problems with null valued and dangling tuples, multivalued dependencies.

Transaction Processing Concepts: Transaction Properties & States, Schedules, Serial & Concurrent Schedule, Serializability of schedules, conflict & view serializable schedule, Recoverability, Recovery from transaction failures, log-based recovery, checkpoints, Deadlock handling.

Concurrency Control Techniques: Concurrency control, Concept of Locks, Concurrency Control Protocols - Two Phase Locking Protocols, Time stamping protocols, validation-based protocol, multiple granularities, Multi version schemes, Recovery with concurrent transactions.

File Structures: File Organization, Indexing, Primary, Clustered, Secondary Indexes, Hashing, Multilevel Indexing with B-Tree, B+ Tree

Course Outcomes

- INT2103.1: Identify the basic concepts of Relational Database Management System and compare various data models used in database design.
- INT2103.2: Identify the Entity relationship modelling concepts & mapping to relational models & apply the design concepts for real world problems.
- INT2103.3: Analyze various Relational Formal Query Languages.
- INT2103.4: Recognize the use of normalization in database design and apply normal forms to carry out schema refinement.
- INT2103.5: Apply and relate the concept of transaction, concurrency control and recovery in database.
- INT2103.6 Explain the database file storage structures and access techniques, concepts of indexing using B tree & B+ Tree.

Text and Reference Books

Textbook(s):

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, (6e), McGraw Hill, 2021.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database System, (6e), Pearson Education India, 2017.

Reference Book(s):

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, (3e), McGraw Hill, 2014.
2. Ivan Bayross, SQL, PL/SQL The Programming Language of Oracle, (4e), BPB Publications, 2010.
1. 3. C. J. Date, An Introduction to Database Systems, (8e), Pearson Education India, 2003.

INT2120 C++ Programming [3 1 0 4] (Flexi Core-1)

Syllabus

Introduction: Basic Data Types in C++, Structure of C++ Program, Control and Iterative Statements in C++, Structures in C++, Basic I/O in C++, Formatted Input and Output, Role of Functions in C++, Operator Overloading;



Strings and Arrays in C++: Defining 1-D and Multi-Dimensional Arrays in C++, Operations on character arrays and Strings., Differences between character arrays and Strings, Use of important String Manipulation Functions; **Dynamic Allocation Functions:** calloc(), free(), malloc(), realloc(), Examples of Dynamic Memory Allocation; **Classes and Objects in C++:** Creating Objects and Defining Classes in C++, Role of Constructor and Destructor Methods, Role of private, public and protected fields; **Function Overloading:** Function overloading in C++, Virtual Functions, Inline Functions; **Inheritance in C++:** Role of Scope Resolution Operator, Base and Derived Classes, Defining single and multiple inheritance.

Course Outcomes

- INT2120.1: Understand the structure of a typical C++ Program and also its compiling and execution.
- INT2120.2: Understand the Classes and Objects of C++.
- INT2120.3: Understanding Inheritance and Polymorphism in C++.
- INT2120.4: Apply the concepts of Inheritance and Polymorphism to solve real world applications.

Text and Reference Books

Textbook(s):

1. C++: The Complete Reference, Herbert Schildt, McGraw-Hill/Osborne

Reference Books

1. Learn To Program With C++, John Smiley,
2. C++ Primer (5th Edition), Josée Lajoie and Stanley B. Lippman
3. The C++ Programming Language, Bjarne Stroustrup,

INT2121: Python Programming [3 1 0 4] (Flexi Core-1)

Syllabus

Introduction to Python : Python Basics : Print statement, Comments, Variables, Keywords, Identifiers, Literals, operators • String Operations in Python • Simple Input & Output • Output Formatting Python Program Flow • Conditional statement • Looping Construct • Range Function • Break & Continue • Assert • Lists • Tuples • Sets • Dictionaries • Collections • Operations on Data Structures. Functions & Modules: User Defined Functions, Functions Parameters, Variable Arguments, Scope of a Function, Function Documentations, • Lambda Function Map, Filter and Reduce • Creation of Module. • File Handling • File handling Modes • Reading Files • Writing & Appending to Files • Handling File Exceptions • The with statement. Object and Classes: Classes in Python, Principles of Object Orientation, Creating Classes • Instance Methods. Exceptions Handling: Errors, Exception handling with try, handling Multiple Exceptions, Writing your own Exception Module. • Numpy: Introduction to numpy, Creation of vectors and matrices, Matrix manipulation, functions of Numpy. • Pandas: Introduction to Pandas, Pandas data structures – Series and DataFrame, Data wrangling using pandas, Loading a dataset into a dataframe, Selecting Columns from a dataframe, Selecting Rows from a dataframe, Adding new data in a dataframe, Deleting data from a dataframe.

Course Outcomes

- INT2121.1: Demonstrate the concepts of basic commands and control structures in Python.
- INT2121.2: Implement Python programs using functions and strings.
- INT2121.3: Implement methods to create and manipulate lists, tuples and dictionaries.
- INT2121.4: Create array and implement different methods of array.
- INT2121.4: Create dataframe and implement methods for manipulating data.

Text and Reference Books

Text Book(s)

1. “Java : The Complete Reference”, Herbert Schildt, 12th Edition, McGraw Hill, 2022.

Reference Books

1. Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock, 2015, ISBN: 978-1593275990.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
3. Reema Thareja, “Python Programming using problem solving approach”, Oxford University press, 2017. ISBN-13: 978-0199480173

INT2130 Data Structures and Algorithms Lab [0 0 2 1]

Syllabus

Review of C, programs on array, linked list, stacks, recursion, queues, trees, graphs, searching and sorting.

Course Outcomes

- INT2130.1: Able to understand basic concepts of various data structures.



- INT2130.2: Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory and their operations.
- INT2130.3: Apply appropriate data structures to solve problems and assess the trade-offs involved in the design choices and hence develop employability skills.
- INT2130.4: Analyse various sorting algorithms like bubble, selection, insertion, merge sort, heap sort and quick sort.

Text and Reference Books

Text Book(s)

1. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, “Data Structures using C”, Pearson Education, 2013.

Reference Books:

2. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, “Fundamentals of Data Structures in C”, University Press (India) Pvt. Ltd., 2014.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2012.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to algorithms”, PHI, Third Edition, 2009.
5. Seymour Lipschutz, “Data Structures with C (Schaum's Outline Series)”, McGraw Hill Education Private Limited, 2011.
6. Mark Allen Weiss, “Data structures and Algorithm Analysis in C”, Pearson, Second edition, 2014.

INT2131 Relational Database Management System Lab [0 0 2 1]

Syllabus

- Database Foundations: Introduction, Databases and Data Modelling, Refining the Data Model, Oracle SQL Developer Data Modeler, Introduction to SQL.
- Database Design – Introduction, Entities and Attributes, Super/Sub Types and Business Rules, Relationship Fundamentals, UIDs and Normalization, Arcs, Hierarchies, and Recursive Modelling, Mapping, Creating Database Projects, Presenting Database Projects.
- Database Programming with SQL – Introduction, SELECT, WHERE ORDER BY, and Intro to Functions, Single Row Functions, JOINS, Group Functions, Subqueries, DML, DDL, Constraints, Views, Sequences and Synonyms, Privileges and Regular Expressions, TCL, Final Project, and Exam Review

Remark: The RDBMS LAB Course has been Mapped with the following courses of Oracle Academy

- I. Database Foundations
- II. Database Design and Programming with SQL
- III. Programming with PL/SQL

Course Outcomes

- INT2131.1: Demonstrate the concepts of ER, EER diagrams and introduction to SQL
- INT2131.2: Demonstrate the concepts and queries of DDL
- INT2131.3: Demonstrate the concepts and queries of DML
- INT2131.4: Demonstrate the concepts and queries of DCL
- INT2131.5: Demonstrate the concepts of stored procedures and transaction to acquire efficient database management skill

Text and Reference Books

Textbook(s)

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, (6e), McGraw Hill, 2021.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database System, (6e), Pearson Education India, 2017.

Reference Book(s)

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, (3e), McGraw Hill, 2014.
2. Ivan Bayross, SQL, PL/SQL The Programming Language of Oracle, (4e), BPB Publications, 2010.
3. C. J. Date, An Introduction to Database Systems, (8e), Pearson Education India, 2003.

INT2170 Project Based Learning 1 [0 0 2 1]

Syllabus

The objective of the course is to enhance and improve the knowledge and problem-solving skills of students through a dedicated project work on some real-world problem. As a part of this course, a student either alone or in a group has to do a project work under the supervision of either one or more faculty members. The project work can be



allocated by the faculty members or student can propose his own identified problem statement. The project can be an implementation-based coding project or a research-oriented work. At the end of the course, the student has to demonstrate the executable working of project in case of a coding project or an outcome of literature review type work in case of research-oriented project.

Course Outcomes

- INT2170.1: Define a problem within a given domain within constraints.
- INT2170.2: Understand the importance of literature review in problem identification.
- INT2170.3: Understand the importance of collaborative teamwork.



Detailed Course Syllabus

Year: II, Semester: 04

S.No	Course Code	Course Name	L	T	P	C
1	MAS2001	Statistics and Probability	3	0	0	3
2	INT2201	Operating Systems	3	1	0	4
3	INT2202	Object-Oriented Programming	3	1	0	4
4	INT2220/INT2221	Data Communications / Modern Web Technologies	3	1	0	4
5	INT22XX	Program Elective 1	3	0	0	3
6	INT2230	Operating Systems Lab	0	0	2	1
7	INT2231	Object-Oriented Programming Lab	0	0	2	1
8	INT2270	Project Based Learning 1	0	0	2	1
9	XXXXXX	Open Elective 1	3	0	0	3
Total			18	3	8	25

Choices for Flexible Core 2:

1. INT2220 Data Communications
2. INT2221 Modern Web Technologies

Choices for Program Elective 1:

1. INT2240: Computer Organization and Microprocessors
2. INT2241: IoT Fundamentals
3. INT2242: Python Programming Fundamentals [Note: student should not have taken the INT2121 Python Programming Course as flexible core in 3rd semester.]

MAS2001 Statistics and Probability [3 0 0 3]
Syllabus
Probability Theory and Random Variables: Probability (Only One Lecture), Random variables, Cumulative distribution functions, Discrete random variables, Continuous random variables, Independent random variables, Probability mass and density functions, Expectation of random variables, Chebyshev's inequality, Central limit theorem. Probability distribution: Binomial, Poisson, Uniform, Normal, Exponential Theory of Estimation: Maximum Likelihood and method moment estimation, Sufficient statistics, Bayesian estimation, Confidence intervals for means. Tests of Statistical Hypothesis: Introduction, Parameter and Statistic, Standard error, Statistical hypotheses, Critical region, Tests of hypotheses and significance, Type I and Type II errors, level of significance. level of significance, Test about one mean, Test about equality of two means, Test of variances, Chi square test, Analysis of Variance.
Course Outcomes
- MAS2001.1: Understand the concepts of probability and random variables to analyze and solve a wide range of real-world problems under uncertainty principles and make decisions in practical scenarios. - MAS2001.2: Employ probability distributions to effectively model and analyze real-world engineering problems. - MAS2001.3: Describe point and interval estimators for parameter estimation to provide reliable and accurate conclusions in industry and business for effective decision-making. - MAS2001.4: Formulate and test the Hypothesis related to engineering problems and enhance decision-making and employability.
Text and Reference Books
- Goon, A.M., Gupta, M.K. and Dasgupta, B., An Outline of Statistical Theory, Vol. II, 3rd Edn. World Press, Kolkata, 2005. - Kendall and Stuart, Advanced Theory of Statistics Vol.-II, Charles Griffin & Co. Ltd, London, 1961. - Casella, G. and Berger, R.L., Statistical Inference, Second Edn. Thomson Duxbury, 2002. - Hogg, R.V. and Tanis, E.A., Probability and Statistical Inference, 3rd Edn. Macmillan Publishing Co. Inc., 1988. - Feller, W., An Introduction to Probability Theory and Its Applications, Vol. 1, 3rd Edition, John Wiley, 1968.

INT2201 Operating Systems [3 1 0 4]
Syllabus
Introduction: Definition of operating systems, Single and multi-processor systems, Operating system services, System commands and system calls, Interrupt, System boot, Operating system structure, Types of OS, Multi-user, Multitasking, Embedded, Real-time, Network, Distributed; Process and Thread: Process concept, Operations on processes, Inter-process communication, UNIX pipes, Multithreading, Multithreaded models, Programs using PThread; Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms. Synchronization: Critical section problem, Dekker's algorithm, Peterson solution, Synchronization hardware, Semaphores, Classical problems of synchronization, Deadlock, Methods for handling deadlock- prevention, avoidance, detection, and recovery; Memory Management: Address binding, Logical vs Physical address space, Swapping, Contiguous memory allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Page Replacement Policies, Allocation of Frames, Thrashing; File System Interface and Implementation: File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File System Structure, File System Implementation, Allocation Methods, Free Space Management; Disk Management: Disk Scheduling Algorithms, Disk Management, Swap Space Management; Case Studies: Linux, Windows, IS, Android.
Course Outcomes
- INT2201.1: Describe the objectives, structure, functionality, and types of operating systems. - INT2201.2: Understand the role of processes, process states and process scheduling in modern operating systems. - INT2201.3: Understand the concept of process synchronization using mutex locks, semaphores etc. - INT2201.4: Understand the concept of deadlocks, deadlock detection and recovery techniques. - INT2201.5: Understand the concept of virtual memory, memory management, disk scheduling, and security.
Text and Reference Books
Text Book(s) Silberschatz, P. B. Galvin, G. Gagne, <i>Operating System Concepts</i>, (9e), Wiley, 2014. ISBN 978-1-118-06333-0



Reference Books

1. A.S. Tanenbaum, H. Bos, *Modern Operating Systems*, (4e), Pearson, 2015. ISBN · 9789332575776, 9332575770
2. W. Stallings, *Operating Systems: Internals and Design Principles*, (9e), Pearson, 2018. ISBN 978-1118129388

INT2202 Object-Oriented Programming [3 1 0 4]

Syllabus

Introduction: Objects, Classes, Encapsulation, Polymorphism, Inheritance; **Java Basics:** Compilation and Execution of a Java program, Java Compiler and Interpreter, Data Types in Java; **Class Definition and Object Creation:** Instance-Fields/Attributes, Methods, Access Modifiers, Constructors, Object vs Class Variables; Role of static and final keywords in Java, Type Conversion and Promotion; **Polymorphic Forms:** Method Overloading, Objects as Parameters and return types; **Input-Output :** Reading Input and Output in Java; **Object Class in Java :** String form of an Object via to String() method, Object equality method; **Arrays and Strings in Java:** 1-D Arrays, 2-D and Multi-dimensional arrays, Variable Size array, Dynamic Arrays using Array Lists, Strings in Java via String, StringBuilder and StringTokenizer classes; **Inheritance in Java:** Extending classes, abstract classes, final classes, Method Overriding, Runtime Polymorphism, Inner Classes – static and non-static nested Classes, Local Classes; **Inheritance via Interfaces:** class vs interface, defining interfaces, implementing multiple inheritance; Comparator and Comparable interfaces, Iterators and List Iterators, Linked Lists; **Exception Handling:** Exceptions, Defining and Creating Exceptions, Use of Exceptions in Real Life Problems; **Package in Java:** Defining and Creating Packages, importing packages; **Garbage Collector:** Role, definition, explicit call; **Multithreading:** Thread class, Runnable interface, thread life cycle, synchronization, thread priority, creating and running threads.

Course Outcomes

- INT2202.1: Understand the principles of encapsulation and abstraction via objects and classes.
- INT2202.2: Understand the use of various polymorphic forms using classes and interfaces.
- INT2202.3: Learn the application of various forms of inheritance in real life programming problems.
- INT2202.4: Understand the advanced programming concepts such as exception handling and multithreading.

Text and Reference Books

Text Book(s):

1. “Java : The Complete Reference”, Herbert Schildt, 12th Edition, McGraw Hill, 2022, ISBN-10 : 9355323719, ISBN-13: 978-9355323712.

Reference Books:

1. “Programming with Java”, E Balagurusamy, 6th Edition, McGraw Hill, 2019, ISBN-10: 9353162343, ISBN-13: 978-9353162344.
2. “Object Oriented Programming Through Java”, Vishwajeet Barbudhe, 1st Edition, 2020, ISBN-10: 1648690874, ISBN-13: 978-1648690877.

INT2220 Data Communications [3 1 0 4] (Flexi Core- 2)

Syllabus

Introduction: Data communications, Networks, Network types, Standards. **Network Protocols:** Introduction, Need for protocol architecture, OSI Model, TCP/IP protocol architecture. **Data Transmission:** Concepts and terminology, Analog and digital data transmission, Transmission impairments, Channel capacity, Transmission Media. **Signal Encoding Techniques:** Analog and digital Signals, Digital-to-digital conversion: Line coding schemes, Block coding, scrambling, Analog-To-Digital Conversion: Pulse code modulation, Delta modulation. **Digital Data Communication Techniques:** asynchronous and synchronous transmission, Types of errors, Error detection, Error correction, Line configurations. **Data Link Layer:** Introduction, Flow control, Error control, High-level data link control. **Multiplexing and Spread Spectrum:** Frequency-division multiplexing, Time-division multiplexing, Code-division multiple access, Space division multiplexing, Spread Spectrum. **Media Access Control (MAC):** Random access, Aloha, Carrier sense multiple access (CSMA), CSMA with collision detection, CSMA with collision avoidance, Code-division multiple access. **Wired LANs (Ethernet)**

Course Outcomes

- INT2220.1: Utilize the fundamental concepts of data communication, transmission media, and transmission impairments on analog and digital transmission.
- INT2220.2: Apply the principles of signal encoding techniques used for digital data to digital signal conversion and analog data to digital signal conversion and compare them.



- INT2220.3: Apply the knowledge of error detection and correction techniques to find and overcome errors encountered during transmission and discuss flow control and error control techniques.
- INT2220.4: Distinguish between multiplexing techniques and spread spectrum techniques for common channel.
- INT2220.5: Apply multiple access techniques for medium access control in wired and wireless network.

Text and Reference Books

Text Book(s):

1. W. Stallings, Data and Computer Communications, (10e), Pearson Education India, 2017.
2. B. Forouzan, Data Communications & Networking, (5e), McGraw Hill, 2017.

Reference Book(s):

1. L. Peterson and B. Davie, Computer Networks: A Systems Approach, (6e), Morgan K. Publishers, 2021.
2. K. R. Fall, W. R. Stevens, TCP/IP Illustrated, (2e), Addison-Wesley Publication, 2011.

INT2221 Modern Web Techniques [3 1 0 4] (Flexi Core- 2)

Syllabus

Introduction: Web Development and Client Side Programming, Protocols Governing Web, Internet Services and Tools, Client-Server Computing; HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Images, Hypertext Links, Lists, Tables, Forms, HTML5; CSS: Creating Style Sheets, Levels of Style Sheets, CSS Properties, Style Specification Formats, Selector Forms, The Box Model, Conflict Resolution; Javascript: Basic of Javascript, Variables, Arrays and Operators, Functions, Event Handlers, Built-in JS Objects, Form Validations, Conditional and Loops, Debugging and Testing; Introduction to AJAX: AJAX and Node.Js Server, The XmlHttpRequest Object, Handling The Response, JQuery, Passing Data, AJAX Application; PHP Programming: Introduction to PHP, Creating PHP Script, Running PHP Script, Variables and Constants, Data Types, Operators, Conditional Statements, Control Statements, Arrays, Functions, Working With Forms and Databases Connection, Introduction to Web-Server and XAMPP

Course Outcomes

- INT2221.1: Discuss fundamentals and working principles of web technology and web programming.
- INT2221.2: Explain client-side web programming using HTML, Java Script and CSS.
- INT2221.3: Explain server-side programming using PHP and Database interactions.
- INT2221.4: Explain web based application development and deployment on web server and debugging.
- INT2221.5: Apply skills to design websites leading to entrepreneurship opportunities.

Text and Reference Books

Textbook (s):

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 4e, Pearson Education India, 2016

Reference Books:

1. Web Technologies (Black Book) Learning Solutions Inc., Dreamtech Press, 2009.
2. Jackson, Web Technologies: A Computer Science Perspective, (1e), Pearson Education India, 2007.
3. Srinivasan, Web Technology: Theory and Practice, (1e), Pearson Education India, 2012.
4. Godbole A., Khate A., Web Technologies, (3e), McGraw Hill Education, 2017.
5. Gopalan N. P., Akilandeswari J., Web Technology: A Developer's Perspective, (2e Revised), Prentice Hall India Learning, 2014.
6. Roy U.K., "Web Technologies", Oxford Press, 2010.

INT 2240 Computer Organization and Microprocessor [3 0 0 3] (Program Elective-1)

Syllabus

Input-Output Organization: Peripheral devices, I/O interface, Data Transfer Schemes, Program Control, Interrupt, DMA Transfer, I/O Processor; **Memory Organization:** Memory Hierarchy, Processor vs. Memory Speed, High-speed Memory, Cache Memory, Associative Memory, Interleave, Virtual Memory, Memory Management. **8086 MICROPROCESSORS:** Introduction to 8086 – architecture – pin description – External memory interfacing – bus cycle – some important companion chips - Maximum mode bus cycle-memory interfacing - Minimum mode System configuration- Maximum mode system configuration – Interrupts processing – 8087 Numeric data processor - data types – architecture - instruction set. **8086 INSTRUCTION SET AND ADDRESSING MODE :** Addressing modes – Instruction set and assembler directives – Assembly language programming using MASM – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros– Byte and String Manipulation. **Assembly language program using 8086** MASM software and 8086 microprocessor kit Addition, subtraction, multiplication, division,



sorting, searching, string manipulation, code conversion, matrix operation. **I/O INTERFACING:** I/O interfacing – Parallel communication interface – Keyboard /display controller - Timer -D/A and A/D Interface -Serial communication interface —Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller. **Assembly language program using 8086 kit**, for interfacing with 8255, 8253, ADC and DAC,8251.

Course Outcomes

- INT2240.1: Understand Memory and Input Output organization of computer system.
- INT2240.2: To learn the architecture and pin configuration of 8086 Microprocessor.
- INT2240.3: To write assembly language programs using 8086 microprocessors.
- INT2240.4: To interface 8086 Microprocessors with peripheral devices

Text and Reference Books

Text Book(s):

1. M. Morris Mano, “Computer System Architecture”, Pearson, 3rd Edition Revised, 2017.

Reference Books:

1. W. Stallings, “Computer Organization and Architecture –Designing for Performance”, PHI, 2009.
2. Krishna Kant, “Microprocessors and Microcontrollers”, Prentice Hall of India, 2013
3. Douglas V.Hall, —Microprocessors and Interfacing, Programming and Hardware, TMH,2012

INT2241 IoT Fundamentals [3 0 0 3] (Program Elective-1)

Syllabus

IOT Fundamentals: What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues, sensors and actuators. IoT protocols: Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols. Issues with IoT Standardization: Unified Data Standards Protocols, IEEE802.15.4, BACNet Protocol, Modbus, KNX, Zigbee, IoT Architecture: IoT Open source architecture (OIC), OIC Architecture & Design principles, IoT Devices and deployment models. IoT Security: Attack Models: Attacks to Sensors in IoTs, Attacks to RFIDs in IoTs, Attacks to Network Functions in IoTs, Attacks to Back-end Systems, Security Services: Security in Front-end Sensors and Equipment, Prevent Unauthorized Access to Sensor Data, M2M Security, RFID Security, Cyber-Physical System Security, Hardware Security, Front-end System Privacy Protection. Networking Function Security: IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security: Secure Resource Management, Secure IoT Databases. Case Studies of IoT: Smart homes and Smart Cities, Connected vehicles, Smart Grid, Healthcare

Course Outcomes

- INT2241.1: Define the Internet of Things (IoT) and identify its key components.
- INT2241.2: Recall different attack models targeting IoT components, including sensors, RFIDs, network functions, and back-end systems.
- INT2241.3: Describe the standardization of protocols for IoT and differentiate between M2M, WSN, SCADA, and RFID protocols.
- INT2241.4: Explain security services related to front-end sensors and equipment, M2M, RFID, cyber-physical systems, and hardware security.
- INT2241.5: Apply knowledge of IoT fundamentals and security principles to analyze case studies in smart homes, smart cities, connected vehicles, smart grid, and healthcare.

Text and Reference Books

Textbook (s)

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, “Introduction to IoT”, Cambridge University Press, 2021.
2. Fei HU, “Security and Privacy in Internet of Things (IoT): Models, Algorithms, and Implementations”, CRC Press, First Edition, 2016.

Reference Books

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), *Architecting the Internet of Things*, Springer, (1e), 2011.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, *The Internet of Things-Key applications and Protocols*, Wiley, (1e), 2012.
3. Russell, Brian and Drew Van Duren, “Practical Internet of Things Security”, Packt Publishing, First Edition, 2016.
4. J. Holler, V. Tsiatsis, C. Mulligan, S. Avesand, S. Karnouskos, D. Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.



5. V. Madiseti, A. Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014.

INT2230 Operating Systems Lab [0 0 2 1]
Syllabus
Programs on Basic Linux Command, Process Systems Calls such as open(), close(), read(), write(), fork(), exec() etc., Process Synchronization, Threads Creating and Execution, CPU Scheduling, Deadlock and Memory Management.
Course Outcomes
• INT2230.1: Describe the objectives, structure, functionality, and types of operating systems. • INT2230.2: Understand the role of processes, process states and process scheduling in modern operating systems. • INT2230.3: Understand the concept of process synchronization using mutex locks, semaphores etc. • INT2230.4: Understand the concept of deadlocks, deadlock detection and recovery techniques. • INT2230.5: Understand the concept of virtual memory, memory management, disk scheduling, and security.
Text and Reference Books
Text Book(s) 1. Silberschatz, P. B. Galvin, G. Gagne, <i>Operating System Concepts</i>, (9e), Wiley, 2014. ISBN 978-1-118-06333-0 Reference Books 1. A.S. Tanenbaum, H. Bos, <i>Modern Operating Systems</i>, (4e), Pearson, 2015. ISBN · 9789332575776, 9332575770 2. W. Stallings, <i>Operating Systems: Internals and Design Principles</i>, (9e), Pearson, 2018. ISBN 978-1118129388

INT2231 Object-Oriented Programming Lab [0 0 2 1]
Syllabus
Understanding the Structure of Java Program, Compiling and Executing Java Program on Eclipse Framework, Defining Classes and Creating Objects in Java, Arrays and Strings in Java, Polymorphism in Java, Inheritance in Java, Using Collections in Java, Exception Handling in Java.
Course Outcomes
• INT2231.1: Understand the principles of encapsulation and abstraction via objects and classes. • INT2231.2: Understand the use of various polymorphic forms using classes and interfaces. • INT2231.3: Learn the application of various forms of inheritance in real life programming problems. • INT2231.4: Understand the advanced programming concepts such as exception handling and multithreading.
Text and Reference Books
Text Book(s) 1. "Java : The Complete Reference", Herbert Schildt, 12th Edition, McGraw Hill, 2022, ISBN-10 : 9355323719, ISBN-13: 978-9355323712. Reference Books 1. "Programming with Java", E Balagurusamy, 6th Edition, McGraw Hill, 2019, ISBN-10: 9353162343, ISBN-13: 978-9353162344. 2. "Object Oriented Programming Through Java", Vishwajeet Barbudhe, 1st Edition, 2020, ISBN-10: 1648690874, ISBN-13: 978-1648690877.

INT2270 Project Based Learning 2 [0 0 2 1]
Syllabus
The objective of the course is to enhance and improve the development skills of students through a dedicated project work on some real-world problem. As a part of this course, a student either alone or in a group has to do either propose a fresh project-work or can continue the project work carried by the student in third semester under the supervision of either one or more faculty members. At the end of the course, the student has to demonstrate the executable working of project in case of a coding project or further progress made by the student after carrying out the literature review type work in third semester.
Course Outcomes



- INT2270.1: Design a solution to an already identified problem within a given domain within constraints.
- INT2270.2: Understand the importance of collaborative teamwork.

Detailed Course Syllabus

Year: III, Semester: 05

S.No	Course#	Course Name	L	T	P	C
1	INT3101	Design and Analysis of Algorithms	3	1	0	4
2	INT3102	Software Engineering	3	1	0	4
3	INT3120/INT3121	Artificial Intelligence / Theory of Computation	3	1	0	4
4	INT31XX	Program Elective 2	3	0	0	3
5	INT31XX	Program Elective 3	3	0	0	3
6	INT3130	Design and Analysis of Algorithms Lab	0	0	2	1
7	INT3131	Software Engineering Lab	0	0	2	1
8	INT3170	Project Based Learning 3	0	0	2	1
9	XXXXXX	Open Elective 2	3	0	0	3
Total			18	3	6	24

Choices for Flexible Core 3:

1. INT3120 Artificial Intelligence
2. INT3121 Theory of Computation

Choices for Program Elective 2:

1. INT3140: Advanced Java
2. INT3141: Soft Computing Techniques

Choices for Program Elective 3:

1. INT3142: Foundation of Data Science
2. INT3143: Distributed Computing
3. INT3144 Cryptography and Network Security



INT3101 DESIGN & ANALYSIS OF ALGORITHMS [3 1 0 4]

Syllabus

Introduction: Algorithm Definition and Criteria of Algorithms, Iterative and Recursive algorithms, **Performance Analysis:** Priori and Posteriori Analysis, Asymptotic Notations, Space Complexity, Time Complexity, Performance measurement of iterative and recursive algorithms, **Solving Recurrence Relations:** Substitution Method, Iterative Method, Recursive Tree Method, Master Method, **Divide and Conquer:** Introduction, Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort, Randomized Quick Sort, Integer Multiplication. **Graph Search Algorithm:** Graph representation, Breadth First Search and Depth First Search, **Greedy Strategy:** Introduction, Knapsack Problem, Job Sequencing with Deadlines, Huffman Coding, Union and Find Operation (Set and Disjoint Set), Minimum Cost Spanning Tree Algorithms (Prim's and Kruskal's), Optimal Merge Patterns, Single Source Shortest Path (Dijkstra's Algorithm). **Dynamic Programming:** Introduction, Single Source Shortest Path (Bellman and Ford Algorithm), All Pair Shortest Path (Floyd Warshall's Algorithm), Optimal Binary Search Trees, 0/1 Knapsack Problem, Travelling Salesperson Problem, Longest Common Subsequence, Matrix Chain Multiplication, Edit distance. **Backtracking:** Introduction, N-Queens Problem, Graph Colouring and Hamiltonian Cycles, **Branch and Bound:** Introduction, FIFO and LC Branch and Bound, 0/1 Knapsack Problem, Travelling Salesman Problem. **String Matching:** Naïve String Matching, Rabin Karp Algorithm, Knuth-Morris-Pratt Algorithm. **Complexity Classes:** NP, NP-Complete and NP-Hard Problems, Cook's Theorem, Polynomial time reductions, Satisfiability, Reduction from Satisfiability to Vertex Cover.

Text and Reference book(s):

1. Fundamentals of Computer Algorithms, (2e), Horowitz E, Sahni S and Rajasekaran S, University Press, ISBN0-7167-83, 2007.
2. Introduction to Algorithms, (3e), Cormen T H, Leiserson T H, Rivest R L, and Stein C, MIT Press, ISBN-10: 9780262033848, ISBN-13: 978-0262033848, 2009.
3. Design and Analysis of Computer Algorithms, (1e), Aho A V, Hopcroft J E and Ullman J D, The Pearson Education India, ISBN-13:978-0201000290, ISBN-10: 9780201000290, 2007.

Proposed Course Outcomes:

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

- INT3103.1: Analyse the running times of algorithms using asymptotic analysis and argue the correctness of algorithms.
- INT3103.2: Demonstrate and Design algorithms using divide-and-conquer paradigm to solve business problems hence enhance skills.
- INT3103.3: Illustrate the concept of greedy and dynamic-programming approach to solve real life problems to enhance entrepreneurship capabilities.
- INT3103.4: Demonstrate the concept of backtracking and branch & bound algorithms to solve complex engineering problems.
- INT3103.5: Synthesize and analyse various advanced algorithms concept such as graphs, string matching and complexity classes to enhance employability

INT3102 Software Engineering [3 1 0 4]

Syllabus

Introduction to Software Engineering: Software Components, Software Characteristics, Software Engineering Processes; **Software Development Life Cycle (SDLC) Models:** Phases of SDLC, Waterfall model, Prototype Model, Spiral Model, Agile and Scrum Method. **Requirement Engineering:** Analysis, Data Flow Diagrams, SRS, Seven principle of Requirement Engineering; **Estimation:** Planning of project, Estimation of Various Parameters such as Time, Cost, Efforts, Constructive Cost Models (COCOMO) and its Types, Function Point, Reusability, Object Points, The Putnam Resource Allocation Model Use Case Point, Class Point Method Estimation; **Software design:** Architectural view, Low Level Design, Modularization, Coupling and



Cohesion Measures, Object Oriented concepts, Object Oriented analysis, design concept, design methodology, Unified Modelling Language (UML); **Coding Standards:** Code Review and Walkthrough, Code Inspection. ; **Risk Management:** Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, PERT, CPM; Object oriented Metrics basis ; **Software Testing:** Testing Objectives, Testing and Debugging, Various Types of Testing Methods, Black Box and White Box Testing. ; **Software Maintenance:** Categories of Maintenance, Maintenance Process, Regression Testing, Software Re-Engineering, Reverse Engineering, Configuration Management and Certification. **Software Quality:** Quality factors, SEI Capability Maturity Model, Verification and Validation, SQA Plans, Software Quality Frameworks, CMM – 5 level , ISO 9126 Model, Certification Case Study.

Proposed Text and Reference Book(s):

Textbook(s):

1. K. K. Aggarwal and Y. Singh, Software Engineering, (3e Reprint), New Age International Publishers, 2016., ISBN No- 978-8122423600
2. R. S. Pressman, Software Engineering: A Practitioners Approach, (7e Reprint), McGraw Hill, 2016. ISBN10: 1259872971 | ISBN13: 9781259872976

Reference Books:

1. R. Mall, Fundamentals of Software Engineering, (4e), Prentice Hall India, 2016. *ISBN-13:* 978-8120324459 *ISBN-10:* 8120324455.

Proposed Course Outcomes:

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

- INT3102.1: Apply software requirement engineering methods and principles during software development within constraints. These may be environmental, economic, ethical social, political, safety, manufacturability, and sustainability.
- INT3102.2: Produce reliable, robust, and cost-effective efficient software solutions by estimating and planning of the software project within timeframe by designing the model, coding, implementing the software systems
- INT3102.3: Test, debug the code, to measure the matrix, reliability, quality and complexity of the software system
- INT3102.4: Understand software maintenance, some ethical and professional issues that are important for software engineers
- INT3102.5: Follow the professional and ethical responsibility, and industry policy within the time frame of the project. It grasps the impact of engineering solutions in a global, economic, environmental, and in societal context.

INT3120 Artificial Intelligence [3 1 0 4] (Flexi Core-3)

Syllabus

Artificial Intelligence: Introduction to Artificial Intelligence, Current Trends in AI, Intelligent Agents, Agent v/s Software Program, Classification of Agents, Working of an Agent, Single and Multi-Agent System, Performance Evaluation of Agents, Architecture of Intelligent Agents; AI Problems: Problem Space: Problem analysis; Problem Solving Techniques: Heuristic search Techniques; Game Playing: Min Max Algorithm, alpha beta pruning; Knowledge Representation: Semantic Networks, Propositional and Predicate Calculus, Semantics for Predicate Calculus, Theorem Prover, Inference Rules, Unification, Resolution, Refutation in Predicate Logic; Reasoning in AI: Deductive Reasoning, Inductive Reasoning, Abductive Reasoning, Common Sense Reasoning, Monotonic Reasoning, Non-monotonic Reasoning, Probabilistic Reasoning in AI: Bayes Theorem, Learning Fundamentals: Supervised learning (Basics of Classification and Regression), Unsupervised learning (Basics of Clustering and Association), Reinforcement Learning, Planning The Planning problem, planning with state space search, partial order planning, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.

Text and Reference Book(s):

1. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.
2. Kevin Night, Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill, 2008
3. Vinod Chandra SS, Anand Hareendran S, “Artificial and Machine Learning”, First Edition, PHI Learning, 2014.



Proposed Course Outcomes:

- INT3120.1: Discuss basics of Artificial intelligence and some representative applications of artificial intelligence.
- INT3120.2: Formalise a given AI problem and analyse it along different dimensions.
- INT3120.3: Identify and implement appropriate A.I. search technique to solve the problem.
- INT3120.4: Illustrate knowledge representation using propositional, first order predicate logic and semantic network and apply reasoning process to draw conclusions.
- INT3120.5: Apply different types of reasoning methodology appropriately.
- INT3120.6: Understand and apply planning methodologies appropriately.

INT3121 Theory of Computation [3 1 0 4] (Flexi Core-3)

Introduction: Automata Theory, Mathematical Preliminaries and Notations used in Automata Theory, Basics of Set Theory, Function and Relations; **Finite Automata:** Deterministic and Non-Deterministic Finite Automata, Designing of DFA, Minimization of DFA, Designing of NFA, Epsilon NFA, Mealy and Moore Machines; **Regular Languages and Regular Grammars:** Regular Sets, Chomsky Hierarchy, Regular Expressions, Regular Grammar, RL to RE, RE to FA, FA to RE, Pumping Lemma for Regular Languages; **Context Free Languages and Grammars:** CFL & CFG, Ambiguity, Methods for Transforming Grammars; **Push Down Automata:** Non-Deterministic Push Down Automata and Deterministic Push Down Automata, Design of NPDA and DPDA; Conversion of PDA to CFG and CFG to PDA, 2-Stack PDA **Introduction to Turing Machine:** Basics of Turing Machine, Designing of Turing Machine, Variants of Turing Machines, Undecidability Problems.

Text and Reference Book(s):

Text Book(s):

1. An Introduction to Formal Languages and Automata – Peter Linz, Jones and Bartlett Publishers, 6th Edition, 2016, ISBN: 9384323217.

Reference Books:

1. Introduction to Automata Theory, Languages and Computations – J. E. Hopcroft, R. Motwani, J. D. Ullman, Pearson Education India, 3rd Edition, 2008, ISBN: 9788131720479.
2. Introduction to Languages and the Theory of Computation – John C Martin, Tata McGraw Hill, 4th Edition, 2010, ISBN: 0073191469.
3. Theory of Computer Science: Automata, Languages and Computation – K.L.P. Mishra, N. Chandrashekhara, PHI, 3rd Edition, 2006, ISBN: 9788120329683

Proposed Course Outcomes:

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

- INT3131.1: Understand the fundamental concepts used in automata theory and formal languages.
- INT3131.2: Understand the construction of finite automata and regular expressions
- INT3131.3: Understand the properties of context free language and construct push down automata.
- INT3131.4: Learn the basic properties of Turing machines and compute the tractability and decidability with Turing machine.

INT3140 Advanced Java [3 0 0 3] (Program Elective-2)

Syllabus:

Multithreading: Creating and Running Threads, Thread Synchronization; **GUI Programming:** JFrames, JPanels, JButtons and Other related GUI Component and Container Classes; **Event Handling:** Event Delegation Model, Action Events and Listeners, Mouse Events and Listeners; **Java Database Connectivity (JDBC):** MySQL, JDBC Driver Setup, Creating Connection, updating records of database using JDBC, Applets, Servlets and JSPs.

Text and Reference book(s):

1. “Java The Complete Reference”, Herbert Schildt, McGraw-Hill Education, Special Edition, 2024, ISBN-13: 978-9355326478.
2. “Mastering Java Persistence API (JPA)”, Nisha Parameswaran Kurur, BPB Publications, First Edition, ISBN-13: 978-9355511263.



Proposed Course Outcomes:

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

- INT3140.1: Understand the basics of Java threads and thread synchronization.
- INT3140.2: Apply the principles of AWT and Swing classes in real life software applications.
- INT3140.3: Develop an GUI based application using events and swing classes.
- INT3140.4: Design and Implement application using the principles of JDBC, GUI and event Handling.

INT3141: Soft Computing Techniques [3 0 0 3] (Program Elective-2)

Syllabus

Introduction to Soft Computing: Concept of Computing Systems, Soft Computing Versus Hard Computing, Characteristics of Soft Computing, Some Applications of Soft Computing Techniques;

Fuzzy Logic: Introduction to Fuzzy Logic- Fuzzy Sets and Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Rules, Propositions, Implications and Inferences, Defuzzification Techniques- Fuzzy Logic Controller Design, Some Applications of Fuzzy Logic;

Artificial Neural Networks: Biological Neurons and Its Working, Simulation of Biological Neurons to Problem Solving, Perceptron Training Techniques in ANNs.

Genetic Algorithms, Concept of Genetics and Evolution and its Application to Probabilistic Search Techniques, Basic GA Framework and Different GA Architectures, GA Operators- Encoding, Crossover, Selection, Mutation, etc., Solving Single-Objective Optimization Problems Using GAs,

Multiple Objective Optimization, Concept of multi-objective optimization problems (MOOPs) and issues of solving them. Multi-Objective Evolutionary Algorithm (MOEA). Non-Pareto approaches to solve MOOPs. Pareto-based approaches to solve MOOPs Some applications with MOEAs.

Text Book:

1. Rajasekaran, S. and Vijayalakshmi Pai, G. A., *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis, and Applications*, (2e), Prentice Hall India, 2019.
2. S. N. Sivanandam (Author), S. N. Deepa (Author), *Principles Of Soft Computing*, 3ed, Wiley, 2018
3. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, *Neuro-Fuzzy & Soft Computing- A Computational Approach to Learning and Machine Intelligence*, Person India, 2015

References:

1. Martin, F., Neill, Mc. and Thro, E., *Fuzzy Logic: A Practical approach*, (1e), AP Professional, 2000.
2. Ross, T. J., *Fuzzy Logic with Engineering Applications*, (3e), Willey India, 2010.
3. Mitchell, M., *An Introduction to Genetic Algorithms*, (1e), MIT Press, 2000.
4. Goldberg, D. E., *Genetic Algorithms in Search, Optimization and Machine Learning*, (1e), Pearson Education India, 2008.
5. Pratihari, D. K., *Soft Computing*, (1e), Narosa Publishing, 2008.

Proposed Course Outcomes:

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

- [IT 3141.1] To Identify and acquaint with soft computing techniques and their roles in building intelligent Machines.
- [IT 3141.2] To Acquire knowledge in applying fuzzy logic and reasoning to handle uncertainty and solve engineering problems
- [IT 3141.3] To Acquire knowledge in applying neural networks to pattern classification and regression problems
- [IT 3141.4] To Acquire knowledge in applying genetic algorithms and evolutionary algorithms to combinatorial optimization problems with single and multiple objectives
- [IT 3141.5] To demonstrate skills in developing and testing soft computing techniques to solve real life problems

INT3142 Foundations of Data Science [3 0 0 3] (Program Elective-3)

Syllabus



Descriptive Statistics: Introduction, Data Types and Scales, Population and Sample, Measures of Central Tendency, Measures of Variation, Measures of Shape; **Network mobilization and Probability Distribution:** Probability, Bayes' Theorem, Random Variables, PDF& CDF of Continuous, Random Variable, Binomial Distribution, Poisson Distribution, Exponential Distribution, Normal Distribution, Chi-Square Distribution; **Sampling and Estimation:** Population Parameter & Sample Statistic, Sampling- Probabilistic Sampling, Non-Probability Sampling, Sampling Distribution, Confidence Intervals; **Inferential statistics and Hypothesis Testing:** Setting up a Hypothesis Test, One-Tailed and Two-Tailed Test, Z-Test, t-test, Non-Parametric Tests: Chi-Square Tests; **Analysis of Variance and correlation:** One-way ANOVA, Two-way ANOVA, Correlation Analysis, Pearson Correlation Coefficient, Spearman Rank Correlation, Point Bi-Serial Correlation, The Phi-Coefficient; **Applied Linear Algebra:** Eigen Values and Eigen Vectors, Linear Algebra in Dimensionality Reduction, Linear Algebra in Natural Language Processing, Linear Algebra in Machine Learning.

Proposed Text and Reference Book(s):

Text Book(s):

1. Probability & Statistics for Engineers & Scientists (9th Edn.), Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall Inc, 2017
2. Kevin P. Murphy, Machine Learning - A Probabilistic Perspective, MIT Press, ISBN-13: 978-0262018029, 2012.

Reference Books:

1. H. Trevor et al., The Elements of Statistical Learning, (2e), Springer, ISBN 978-0-387-84858-7, 2009.
2. C. Douglas and C. George, Applied Statistics and Probability for Engineers, (3e), John Wiley and Sons, ISBN-13: 978-1118539712, 2010.

Proposed Course Outcomes:

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

- INT3142.1: Master descriptive statistics to effectively summarize and describe datasets.
- INT3142.2: Apply probability distributions and Bayes' Theorem to solve real-world problems.
- INT3142.3: Conduct hypothesis testing and construct confidence intervals for statistical inference.
- INT3142.4: Utilize linear algebra techniques in dimensionality reduction and machine learning applications.

INT3143 Distributed Computing [3 0 0 3] (Program Elective-3)

Syllabus

Introduction: Logical Time vs Vector Time, Shared Memory vs Message Passing, Terminology and basic algorithms; **Message Ordering and Group Communication:** FIFO vs Non-FIFO Order, Causal Ordering, Synchronous vs Asynchronous Executions, Group Communication; **Distributed Mutual Exclusion:** Token based algorithms, Non-token based approaches, Quorum based approaches; **Distributed Deadlock Detection:** Path pushing models, Edge chasing algorithms, Diffusion based deadlock detection, Global state detection; **Distributed Shared Memory:** Strict Consistency vs Linearizability vs Atomicity, Release consistency vs Entry Consistency Models; **Check Pointing and Roll back Recovery:** Local check point vs Global Check Point, Notion of Consistent state, Coordinated vs Non-Coordinated Check Pointing.

Proposed Text and Reference Book(s):

Text Book(s):

1. "Distributed Computing: Principles, Algorithms, and Systems", A.D. Kshemkalyani, M. Singhal, South Asian Edition, Cambridge University Press, 2011, ISBN-10 : 1107648904, ISBN-13: 978-1107648906.

Reference Books:

1. "Distributed Systems: An Algorithmic Approach", Sukumar Ghosh, 2nd Edition, Chapman and Hall/CRC, 2020, ISBN-10 : 0367659123, ISBN-13 : 978-0367659127.
2. "Distributed Systems: Concepts & Design", Coulouris George, Dollimore Jean, Kindberg Tim, Pearson Education, 5th Edition, 2017, ISBN-10: 9789332575226, ISBN-13: 978-9332575226.

Proposed Course Outcomes:



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

- INT3143.1: Understand the basic principles of Logical Time, Vector Time and Distributed Systems.
- INT3143.2: Illustrate the principles of Distributed Mutual Exclusion and Distributed Deadlocks.
- INT3143.3: Apply the principles of distributed algorithms for distributed checkpointing and recovery.

INT3144: Cryptography and Network Security [3 0 0 3] (Program Elective-3)

Syllabus

Introduction: Basics of Information Security, Overview of Cryptography and Cryptanalysis, Active and Passive Attacks; **Classical Ciphers:** Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Vigenère Cipher, Vernam Cipher (One-time pad), Transposition Cipher (Rail Fence, Single Column and Double Column Ciphers), Affine Cipher; **GCD and Multiplicative Inverse:** Euclidean Method for Determining GCD (Integer and Polynomial Both), Extended Euclidean Method for Determining Multiplicative Inverse (Integer and Polynomial Both); **Symmetric Key Cryptography:** Block Cipher and Stream Cipher, Feistel Cipher, Shannon's S-P Networks (Diffusion and Confusion), Simplified-DES, DES, 2DES and 3DES, Meet-in-Middle Attack in 2DES, Finite Field (Groups, Rings, Fields), AES (AES Structure, AES Round Function, AES Key Expansion, AES Decryption, AES S-box Design), Block Cipher Modes of Operations; **Asymmetric Key Cryptography:** RSA Algorithm, Euler Totient Function and Fermat Little Theorem, Diffie Hellman Key Exchange, and El Gamal Cryptosystem, Secure Public Key Distribution; **Authentication Methods:** MAC, CMAC and HMAC; **Hashing Functions:** MD5 and SHA-1, SHA-512; **Digital Signature Algorithm:** RSA Approach and Digital Signature Standard. **Authentication Application:** Kerberos. **Security Systems:** Intrusion Detection System (NIDS & HIDS with Pros and Cons, Signature Based Detection Process, Anomaly Based Detection Process), IP Security (ESP and AH), Secure Socket Layer (Open SSL), Fundamentals of Firewall.

Proposed Text and Reference Book(s):

1. Stallings W, Cryptography and Network Security: Principles and Practice, (7e), Pearson Education India, ISBN 978-1-292- 15858-7, 2017.
2. Katz J, Menezes A J, Van Oorschot PC, Vanstone S A, Handbook of Applied Cryptography, (2e), CRC press, ISBN 0849385237, 2010.
3. Stinson Douglas R., Cryptography: Theory and Practice, (3e), Chapman and Hall / CRC Press, 2005.

Proposed Course Outcomes:

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

- INT3144.1: Define Number Theory used in Cryptography.
- INT3144.2: Discuss different cryptosystems, and their applications in network security.
- INT3144.3: Identify Security attacks and select its identification mechanism.
- INT3144.4: Apply cryptographic mechanisms to provide confidentiality, integrity and availability.
- INT3144.5: Evaluate different crypto systems, and authentication mechanisms for solving real applications in security for increasing employability domain.

INT3130 DESIGN & ANALYSIS OF ALGORITHMS LAB [0 0 2 1]

Syllabus

Implementation of Divide and Conquer Algorithms: Binary Search, Finding Maximum and Minimum, Merge Sort, Quick Sort and Heap Sort. Implementation of Graph Searching Algorithms: Breadth First Search and Depth First Search Implementation of Greedy Algorithms: Knapsack Problem, Minimum Cost Spanning Trees Algorithm (Prim's and Kruskal's). Implementation of 0/1 Knapsack Problem, LCS, LIS, Matrix Chain Problem using Dynamic Programming Algorithm. Implementation of Graph Colouring using Backtracking Algorithm. Implementation of 0/1 Knapsack Problem using Branch and Bound. A lab project / Competitive coding/Codethon as case studies.

Text and Reference book(s):

1. Computer Algorithms, (2e), E. Horowitz, S. Sahni and S. Rajasekaran, University Press, ISBN0-7167-83, 2007.
2. Introduction to Algorithms, (3e), Cormen T H, Leiserson T H, Rivest R L, and Stein C, MIT Press, ISBN-10: 9780262033848, ISBN-13: 978-0262033848, 2009.



3. Design and Analysis of Computer Algorithms, (1e), Aho A V, Hopcroft J E and Ullman J D, The Pearson Education India, ISBN-13: 978-0201000290, ISBN-10: 9780201000290, 2007.

Proposed Course Outcomes:

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

- INT3130.1 Illustrate basic concepts of various algorithm and their complexities.
- INT3130.2 Select and/or apply appropriate algorithm to solve real life problems and assess the trade-offs involved in the design choices also calculate the running time complexity.
- INT3130.3 Demonstrate and analyze various paradigms such as greedy, divide and conquers approach to enhance their skills.
- INT3130.4 Demonstrating dynamic programming, backtracking, branch and bound and graph-based techniques to enhance entrepreneurship skills.
- INT3130.5 Developing employability skills to solve various application based on different designing approach

INT3131 SOFTWARE ENGINEERING LAB [0 0 2 1]

Syllabus:

Requirement Preparation: Prepare Software Requirement Specification of the Project, System modelling: Function Oriented Diagram, Data Flow Diagram. Software Design using (UML) : Use Case Diagram, Class Diagram, Sequence Diagram, Activity Diagram, Collaboration Diagram, Communication Diagram, State Chart Diagram, Interaction Diagram, Component Diagram and Deployment Diagram, Case Study on UML Diagram, Software Testing: Code Level Testing, Functional Testing, Manual Testing, Automated Testing Using Tools

Text and Reference book(s):

1. R. S. Pressman, "Software Engineering: A Practitioners Approach", McGraw Hill, New Delhi Seventh Edition Reprint, 2016.
2. R. Mall, "Fundamentals of Software Engineering", PHI Publication, New Delhi Fourth Edition 2016.
3. K. K. Aggarwal and Y. Singh, "Software Engineering", New Age International Publishers, New Delhi Third Edition 2008, Reprint 2016.
4. P. Jalote, "Software Engineering", Narosa Publishing House New Delhi, Third Edition Reprint, 2012.
5. Subramaniam, "Software Engineering" Pearson Education Print 2015

Proposed Course Outcomes:

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

- IT3132.1: Define the requirement engineering methods and principles during software development.
- IT3132.2: Identify Data Flow diagram, UML diagram of the software project by designing the model.
- IT3132.3: Implementing and debugging the code, use various testing methods to ensure quality and to maintain the software system.
- IT3132.4: Analyze the model of the software system.
- IT3132.5: Formulate the models, the professional and ethical responsibility, and industry policy within the time frame of the project. It grasps the impact of engineering solutions in a global, economic, environmental, and in societal context.

INT3170 Project Based Learning 3 [0 0 2 1]

Syllabus

The objective of the course is to enhance and improve the development skills of students through a dedicated project work on some real-world problem. As a part of this course, a student either alone or in a group has to do either propose a fresh project-work or can continue the project work carried by the student in third semester under the supervision of either one or more faculty members. At the end of the course, the student has to demonstrate the executable working of project in case of a coding project or further progress made by the student after carrying out the literature review type work in third semester.

Course Outcomes

- INT3170.1: Design a solution to an already identified problem within a given domain within constraints.
- INT3170.2: Understand the importance of collaborative teamwork.



Detailed Course Syllabus

Year: III, Semester: 06

S.No	Course#	Course Name	L	T	P	C
1	INT3201	Computer Networks	3	1	0	4
2	INT32XX	Program Elective 4	3	0	0	3
3	INT32XX	Program Elective 5	3	0	0	3
4	INT32XX	Program Elective 6	3	0	0	3
5	INT3210	Professional Practice	0	0	0	1
6	INT3230	Computer Network Lab	0	0	2	1
7	INT3231/INT3232	Machine Learning Lab / Compiler Design Lab	0	0	2	1
8	INT3270	Project Based Learning 4	0	0	6	3
9	XXXXXX	Open Elective 3	3	0	0	3
Total			15	1	10	22

Choices for Program Elective 4:

1. INT3240: Data Analytics using Python
2. INT3241: Cloud Infrastructure and Services
3. INT3242: Secure Programming

Choices for Program Elective 5:

1. INT3243: Data Warehousing and Mining
2. INT3244: Cloud Computing and Virtualizations
3. INT3245: Vulnerability Assessment and Ethical Hacking

Choices for Program Elective 6:

1. INT3246: Compiler Design
2. INT3247: Machine Learning Techniques



INT3201 Computer Networks [3 1 0 4]
Syllabus
Introduction to Computer Networking Concepts: Layered Architectures, OSI Reference Model, TCP/IP Protocol Suite. Physical Layer: Basics of communications; Physical Topology, Physical media types and their important bandwidth and bit-error-rate characteristics; Wired and Wireless media including copper cables, optical fiber and wireless. Data Link Layer: Logical Link Control (LLC) sub-layer: Framing, Error control, a reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat, MAC sublayer: Media access protocol. Network layer: addressing, subnetting, Internet Protocol (IP) suite; IPv4 and IPv6 headers; Routing protocols: distance-vector and link-state approaches; Interior and Exterior Gateway Protocol, ICMP, NAT, ARP and RARP. Transport layer: UDP, TCP: Connection establishment and termination, sliding window, flow and congestion control. Application Layer: Introduction to DNS, SMTP, SNMP, FTP, HTTP.
Proposed Text and Reference Book(s):
Textbook(s): 1. Behrouz A. Forouzan, <i>TCP/IP Protocol Suite</i> , (4e), Tata McGraw Hill, ISBN-10: 0070166781, ISBN-13: 9780070166783, 2010. 2. Tanenbaum A. S., <i>Computer Networks</i> , (5e), Pearson Education India, ISBN-10: 9332518742, ISBN-13: 978-9332518742, 2013.
Reference Book(s): 1. Comer D. E., <i>Internetworking with TCP/IP Principles, Protocols and Architecture</i> , (6e), Pearson Education India, ISBN-10: 1292040815, ISBN-13: 978-1292040813, 2013.
Proposed Course Outcomes:
At the end of the course, the students will be able to INT3201. 1 Become familiar with layered communication architectures based on TCP/IP. INT3201. 2 Understand medium access, routing protocols and addressing mechanisms. INT3201. 3 Know the principles of congestion control and trade-offs in fairness and efficiency. INT3201. 4 Understand the concepts of data transfer in UDP & TCP. INT3201. 5 Know the key Application Layer protocols such as DNS, HTTP, SNMP, SMTP, FTP.

INT3240 Data Analytics Using Python [3 0 0 3] (Program Elective-4)
Syllabus
Introduction: Data Analytics tasks and methods, Data Gathering and Preparation: Data Formats, Parsing and Transformation, Scalability and Real-time Issues; Essential Python Libraries: NumPy, pandas, matplotlib, SciPy, scikit-learn, stats models etc. Data Cleaning: Consistency Checking, Missing Data Estimation, Data Transformation, Normalization and Segmentation in python. Exploratory Analysis: Descriptive and comparative statistics, Statistical Inference, Exploratory data analysis (EDA) and python libraries. Data Analysis Techniques: Regression (Linear regression, multiple regression analysis, Logistic Regression), Basic Classification techniques, Association rule mining, Clustering, Classification and Regression Trees (CART), Entropy based methods, Case studies in python; Time Series Data Analysis: Date and Time Data Types and Tools, Time series Basics, date Ranges, Frequencies and Shifting, Time Zone Handling, Periods and Periods Arithmetic, Resampling and Frequency conversion, Moving Window Functions. Data Visualization: matplotlib, Basics of matplotlib, plotting with pandas and seaborn, other python visualization tools. Case studies and projects.
Proposed Text and Reference Book(s):
Text Book(s): 1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. "O'Reilly Media, Inc." 2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
Reference Books: 1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009. 2. E. Tufte. The Visual Display of Quantitative Information, (2e), Graphics Press, 2012.
Proposed Course Outcomes:



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

- INT3240.1: Execute data gathering, preparation, and cleaning tasks using essential Python libraries.
- INT3240.2: Perform exploratory data analysis and apply statistical inference with Python tools.
- INT3240.3: Implement data analysis techniques such as regression, classification, and clustering in Python.
- INT3240.4: Analyse time series data and create visualizations using libraries and other Python tools.

INT3241 Cloud Infrastructures and Services [3 0 0 3] (Program Elective-4)

Syllabus

Introduction to Cloud Computing, Cloud issues and challenges, Deployment models (Private, Public, Hybrid), Data-storage, Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services, Database as a Services, Anything / Everything as a service (XaaS), Function as a service, Security as a Service, Virtualization concepts, Benefits, Virtualization Structures, Full Virtualizations, Para Virtualization, Virtualization of CPU, Memory and I/O devices, Hypervisors, Cloud Infrastructure Framework, Physical and Virtual Infrastructure, Processes in Cloud Service Management, Role of Cloud, Architect. Cloud Integration and Federation, Classic data Center – Application, DBMS, Compute, Storage, Redundant Array of Independent Disks, RAID Techniques, RAID level, Intelligent Storage System, Compute to compute communication, Compute to storage communication, Direct Attached Storage (DAS), Fibre Channel SAN (FC-SAN), FC SAN Addressing, Zoning, Storage Networking Technologies, capacity management, Performance management, Case Study with examples.

Proposed Text and Reference Book(s):

1. Miller M, “*Cloud Computing*”, 8th Edition, Que Publishers 2008.
2. Buyya R K, “*Cloud Computing: Principles and Paradigms*”, Wiley Press, 2011.
3. B. Jackson, “1. K Saurabh, “*Cloud Computing*”, 2nd Edition, Wiley India
4. Joysula, M Orr, G Page, “*Cloud Computing: Automating the Virtualized Data Center*”, Cisco Press, 2012

Proposed Course Outcomes:

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

- INT3241.1: Understand the phases of transition from classic data center to virtual data center and then to the cloud
- INT3241.2: Analyze key characteristics, services, and deployment models of cloud
- INT3241.3: Implement the cloud infrastructure components and service management processes

INT3242 Secure Programming [3 0 0 3] (Program Elective-4)

Syllabus

Introduction to Secure Programming: Overview of cybersecurity and its importance in software development, Principles of secure programming, Common security threats and vulnerabilities; **Secure Coding Practices:** Input validation and output encoding, Proper error handling and logging, Memory management and buffer overflow prevention, Secure file handling; **Authentication and Authorization:** Authentication mechanisms (e.g., passwords, tokens, biometrics), Authorization models (e.g., role-based access control, attribute-based access control), Implementing secure authentication and authorization in software applications; **Cryptography:** Introduction to cryptographic principles, Symmetric and asymmetric encryption, Digital signatures and message authentication codes (MACs); **Network Security:** Secure communication protocols (e.g., TLS/SSL), Secure socket programming, Mitigating network-based attacks (e.g., man-in-the-middle attacks); **Web Application Security:** Common web vulnerabilities (e.g., SQL injection, cross-site scripting), Best practices for secure web development, Web application firewalls and security frameworks; **Secure Software Development Lifecycle (SDLC):** Integrating security into the software development process, Security requirements analysis, Security testing techniques (e.g., static analysis, dynamic analysis, penetration testing); **Secure Data Handling:** Data



encryption and decryption, Secure storage and transmission of sensitive data, Compliance with data protection regulations (e.g., GDPR, HIPAA).

Proposed Text and Reference Book(s):

Text Book(s):

1. "Secure Coding in C and C++", Robert C. Seacord, 2nd Edition, Addison-Wesley Professional, 2013, ISBN-10: 0321822137, ISBN-13: 978-0321822130.

Reference Books:

1. "The Tangled Web: A Guide to Securing Modern Web Applications", Michal Zalewski, 1st Edition, No Starch Press, 2011, ISBN-10: 1593273886, ISBN-13: 978-1593273880.
2. "Cryptography and Network Security: Principles and Practice", William Stallings, 7th Edition, Pearson, 2016, ISBN-10: 0134444280, ISBN-13: 978-0134444284.

Proposed Course Outcomes:

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

- INT3241.1: Understand the importance of cybersecurity in software development and identify common security threats and vulnerabilities.
- INT3241.2: Apply secure coding practices such as input validation, output encoding, and buffer overflow prevention in software projects.
- INT3241.3: Implement robust authentication mechanisms and authorization models to enhance security in software applications.
- INT3241.4: Analyze and mitigate network-based and web-based security threats using secure communication protocols and best practices in web application security.

INT3243 Data Warehousing and Mining [3 0 0 3] (Program Elective-5)

Syllabus:

Data warehousing Components: Introduction to Data Warehouse, Statistical Observation on Data, Data Types, DBMS Schemas for Decision Support, Data Mart, Data Extraction, Transformation and Load (ETL) Operations, Metadata; Online Analytical Processing (OLAP), Online Transaction Processing (OLTP), ROLAP, MOLAP, HOLAP and their Operations, Bitmap Indexing, Join Indexing, Attribute Selection Measure, Method, Data Cubing, Slicing, Dicing

Data Mining: Introduction Data Mining & Applications, Types of Data, Pre-Processing, Association Rule Mining (ARM): Mining Frequent Patterns, K-Frequent Item Set Mining, A-Priori Algorithm, Associations and Correlations Mining, Correlation Analysis, Constraint Based Association Mining; **Classification and Prediction** : Basic Concepts, Entropy, Decision Tree, Naïve Bayes Algorithm, Neural Networks, Back Propagation, Support Vector Machines, Associative Classification, Lazy Learners, **Clustering:** Basic Concepts, Cluster Analysis, K-Means, Partitioning Methods, Hierarchical Clustering, Expectation Maximization, Density based Clustering, Web Mining, Text Mining, Spatial Mining, Case Study: Case Studies on Various Data Mining Techniques with Varying Data Sets.

Text and Reference book(s):

1. A. Berson and S. J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007. ISBN No- 978-0070587410
2. J.Han and M. Kambher, "Data Mining Concepts and Techniques", Second Edition, Elsevier, 2007, ISBN No - 978-1-55860-901-3
3. P. N. Tan, M. Steinbach, and V. Kumar, "Introduction to Data Mining", Person Education, 2007 ISBN No- ISBN No: 978-1-292-02615-2
4. K.P. Soman, S. Diwakar and V. Ajay, "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006 ISBN No - 978-8120328976

Proposed Course Outcomes:



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

- INT3243.1 Interpret the contribution of data warehousing and data mining to the decision-support level of organizations.
- INT3243.2 Categorize and carefully differentiate between situations for applying different data-mining techniques: frequent pattern mining, association, correlation, classification, prediction, and cluster and outlier analysis.
- INT3243.3 Design and implement systems for data mining
- INT3243.4 Evaluate the performance of different data-mining algorithms
- INT3243.5 Implement data-mining techniques for different applications

INT3244 Cloud Computing and Virtualization [3 0 0 3] (Program Elective-5)

Syllabus

Virtualized Data Centre (VDC): Compute and Storage, VDC Compute and Storage, Virtualized Data Centre , virtualization techniques, Xen Virtualization Architecture, Virtual Machines, VM Resource management techniques, Physical to Virtual Machine Conversion , Hypervisor Management, Virtual Infrastructure Requirements, Storage Virtualization overview, Virtual Machine Storage, Block level and File level virtualization, Virtual provisioning and automated storage tiering, with Case Study, VDC networking overview, VDC networking components, VLAN and VSAN technologies, Network traffic management, Exercise – VDC networking, Desktop virtualization \ Application virtualization, Business Continuity in VDC, Fault tolerance mechanism in VDC, Backup in VDC, replication and deduplication , VM migration , Functioning of VMware vSphere, VMware Fault Tolerance, VMware vMotion, VMware Storage vMotion, Case Study.

Proposed Text and Reference Book(s):

1. Josyula, Venkata, Malcolm Orr, and Greg Page. Cloud computing: Automating the virtualized data center, (1e), Cisco Press, 2011.
2. Ray Rafaels. Cloud computing, (2e), CreateSpace Independent Publishing Platform, 2018.
3. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, Cloud computing: Principles and Paradigms”, (1e), John Wiley & Sons, 2010.

Proposed Course Outcomes:

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

- INT3244.1: Learn virtualization technology at compute, storage, network, desktop, and application layers of its infrastructure
- INT3244.2: Develop business continuity solutions in a virtual data center with the help of virtualization.
- INT3244.3: Implement cloud virtualization and migration in the industry.

INT3245 Vulnerability Assessment and Ethical Hacking [3 0 0 3] (Program Elective-5)

Syllabus

Introduction to Ethical Hacking: elements of information security, information security threats, attack vectors, hacking concepts, types, phases, scope, information security controls, penetration testing process, Hacking Methodology, Foot printing, Scanning, enumeration, system hacking. **Malware threats:** malware analysis, detection, propagation techniques malware countermeasures, Sniffing, Social engineering, Denial of Service, Session Hijacking, Evading IDS and Firewalls. **Web Servers and Web Application vulnerabilities:** concepts, attacks, methodology, countermeasures, security tools, penetration testing. **Hacking Wireless Networks:** concepts, encryption algorithms, threats, hacking methodology, tools, penetration testing. **vulnerability analysis:** classification, vulnerability assessment, vulnerability management life cycle, vulnerability assessment solutions, vulnerability assessment tools, vulnerability scoring systems, Report writing & Mitigation: Introduction to Report Writing & Mitigation, requirements for low level reporting & high level reporting of Penetration testing results.

Proposed Text and Reference Book(s):

1. R. Baloch, Ethical Hacking and Penetration Testing Guide, Auerbach Publications, 2014.
2. P. Engebretson, The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing, (2e), Syngress, 2013.



3. M. Walker, Certified Ethical Hacker All-in-One, (3e), McGraw Hill Education, 2016.

4. S. McClure, J. Scambray, G. Kurtz, Hacking Exposed, (7e), McGraw Hill, 2012.

Proposed Course Outcomes:

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

- INT3245.1: Evaluate the ethical considerations and legal implications in conducting ethical hacking activities using appropriate tools.
- INT3245.2: Analyze and defend against social engineering, physical penetration and insider attacks using automating penetration testing processes.
- INT3245.3: Analyze and critically evaluate techniques used to break into an insecure web application and identify relevant countermeasures.
- INT3245.4: Apply the knowledge of ethical hacking to perform live attacks.
- INT3245.5: Identify legal and ethical issues related to VAPT report on the strength and vulnerabilities of the tested networks.

INT3246 Compiler Design [3 0 0 3] (Program Elective-6)

Syllabus

Compiler Introduction: Overview and phases of compiler; **Lexical Analysis:** Tokens, Patterns, Lexemes and Errors; **Syntax Analysis:** The role of Parser, Context Free Grammar, Recursive Descent Parsing, LL(1) Grammar, Non-Recursive Predictive Descent Parser, Error Handling, Bottom-up Parsing, Reductions, Handle Pruning, Shift-Reduce Parsing, Conflicts, LR Parsing Algorithm, LR(0), SLR(1), CLR(1) and LALR Parsing Tables Construction; **Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDDs; **Intermediate-Code Generation:** Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Boolean Expressions; **Run Time Environment:** Storage Organization, Stack allocation, Heap Management; **Code Generation:** The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, The Principal Sources of Optimization.

Text and Reference book(s):

1. "Compilers, principles, techniques, and tools", Alfred Vaino Aho, Pearson Education India, Second Edition, 2013, ISBN-13 978-9332518667.
2. "Compiler Design", Santanu Chattopadhyay, Prentice Hall India Learning Private Limited, ISBN-13: 978-8120327252

Proposed Course Outcomes:

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

- INT3246.1: Understand the Compiler Phases
- INT3246.2: Apply Parsing Techniques
- INT3246.3: Analyze Syntax-Directed Definitions
- INT3246.4: Evaluate Code Generation Strategies

INT3247 Machine Learning Techniques [3 0 0 3] (Program Elective-6)

Syllabus

Machine Learning Basics: Types of Machine Learning, Supervised vs. Unsupervised Learning, Parametric vs. non-parametric models. Learning theory-bias/variance tradeoff, Underfitting, Overfitting, Model selection, Cost functions. **Curse of Dimensionality:** Principal Component Analysis (PCA), Difference between PCAs and Latent Factors, Factor Analysis, Introduction to gradient descent. **Bayesian Models:** Bayesian concept learning, Bayesian Decision Theory, Naïve Bayesian, Zero Probability & Laplacian Correction, Bayesian Belief Networks. **Tree Models:** information theory, decision tree construction, tuning tree size. ; Support Vector Machines, kernel functions, k Nearest Neighbours. **Regression Models:** Linear Regression, Ridge and Lasso Regression, Logistic Regression, performance measures for classification score models. **Ensemble Models:** Bagging algorithm, Boosting Algorithms: Introduction. **Neural Networks:** Introduction, ANN, Type of ANN, Perceptron, Back Propagation. **Unsupervised learning:** Partitioning, Hierarchical and Density based methods.

Textbook(s) and Reference Book(s):

Textbook(s):

1. K. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.



2. G. James, D. Witten, T Hastie, R Tibshirani, An introduction to statistical learning with applications in R, Springer, 2013.

3. J. Han, M. Kamber, J. Pei, Data Mining concepts and techniques, (2e), Morgan Kaufmann- Elsevier, 2011.
Reference Book(s):

1. T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning, (2e), Springer, 2009.

2. T. M. Mitchell, Machine Learning, (Indian Edition), MacGraw Hill, 2017.

3. C. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2019.

Proposed Course Outcomes:

- INT3247.1: Understand and Apply scaling up machine learning techniques and associated computing techniques and technologies.
- INT3247.2: Recognize and Implement various ways of selecting suitable model parameters for different machine learning techniques.
- INT3247.3: Integrate machine learning libraries and mathematical and statistical tools with modern technologies.
- INT3247.4: Select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.
- INT3247.5: Apply data analytics and prediction skills with automation.

INT3210 Professional Practice [0 0 0 1]

Syllabus:

Professional practices in engineering: articulate aspirations, career goals and intended activities to potential employers, highlighting key personal and professional capabilities and competencies, to secure a position. Participate in and demonstrate evidence of ethical, professional and efficient work practices in IT/data science. Use reflective practice to document discipline- specific (course learning outcomes) and generic competencies (graduate learning outcomes) required to become an IT professional/data scientist, drawn from placement experience. Show capacity for preparing personal and professional development plans, which contribute to the job search/career development process. Life Skills: Behavior and attitude, The Big Five Personality Model (Professional ethics, responsibility C Integrity). Major job attitude, Job satisfaction, The Myers-Briggs Type Indicator. Essential elements of effective presentations, speaking as a leader, presenting yourself professionally, developing your interpersonal skills. Writing and Listening Skills: Written Communication: Principles of effective writing, Professional Email Writing etiquette. Listening Skills: listening process, classification of listening, purpose of listening. Resume writing Job Interview Readiness: Guidelines for writing resumes, different types of resumes, reason for a cover letter to apply for a job, different types of cover letters. importance and factors involving job interview, characteristics of job interview, job interview techniques, manners and etiquette to be maintained during an interview.

Reference Book(s):

1. D. A. Whetten and K. S. Cameron, Developing Management Skills, 8th Ed., Pearson, 2017.

2. A. Wadkar, Life Skills for Success, 1st Ed., Sage Publications, 2016

Proposed Course Outcomes:

- INT3210.1: Apply ethical principles and professional responsibility in engineering practice.
- INT3210.2: Demonstrate self-management, integrity, teamwork, and legal awareness in professional environments.
- INT3210.3: Communicate effectively through professional written, verbal, and presentation skills.
- INT3210.4: Develop career-readiness skills for employment and professional growth.

INT3230 Computer Networks lab [0 0 2 1]

Introduction to NetSim, Understand Measures of Network Performance: Throughput and Delay, Understand working of ARP, and IP Forwarding within a LAN and across a router, Simulate and study the spanning tree protocol, Introduction to TCP connection management, Reliable data transfer with TCP, Mathematical Modelling of TCP Throughput Performance, TCP Congestion Control Algorithms, Study the working and routing table formation of Interior routing protocols, i.e. Routing Information Protocol (RIP) and Open Shortest Path First (OSPF), Understand the working of basic networking commands (Ping, Route Add/Delete/Print, ACL), Understanding VLAN operation in L2 and L3 Switches, Understanding Public IP Address & NAT (Network



Address Translation), Understand the working of TCP BIC Congestion control algorithm, simulate and plot the TCP congestion window, Simulating Link Failure
Proposed Text and Reference Book(s):
Textbook(s): 1. Behrouz A. Forouzan, <i>TCP/IP Protocol Suite</i> , (4e), Tata McGraw Hill, ISBN-10: 0070166781, ISBN-13: 9780070166783, 2010. 2. Tanenbaum A. S., <i>Computer Networks</i> , (5e), Pearson Education India, ISBN-10: 9332518742, ISBN-13: 978-9332518742, 2013.
Reference Book(s): 1. Comer D. E., <i>Internetworking with TCP/IP Principles, Protocols and Architecture</i> , (6e), Pearson Education India, ISBN-10: 1292040815, ISBN-13: 978-1292040813, 2013.
Proposed Course Outcomes:
At the end of the course, the students will be able to • INT3230.1: Demonstrate the concepts of NetSim network simulator and network connecting devices. • INT3230.2: Demonstrate the concept of topology and configuration. • INT3230.3: Demonstrate the implementation of different protocols. • INT3230.4: Demonstrate the concepts NAT protocol configuration. • INT3230.5: Demonstrate the usage different network utilities.

INT3231 Machine Learning Lab [0 0 2 1]
Syllabus: Intro to ML Tools: Setup Python, Jupyter, scikit-learn, TensorFlow. Supervised Learning: Linear & Logistic Regression: Implement and evaluate models. Decision Trees & SVM: Build and tune models, understand overfitting. k-NN: Experiment with k-values and distance metrics. Unsupervised Learning: PCA: Perform dimensionality reduction. Clustering: Implement K-Means and hierarchical clustering. Bayesian Models: Naïve Bayes: Apply for text classification, handle zero probability. Bayesian Networks: Simple inference and network construction. Ensemble Methods: Bagging & Boosting: Implement and evaluate using decision trees. Neural Networks: ANN: Build simple models, explore backpropagation. Model Evaluation & Tuning: Cross-validation, grid search, performance metrics.
Textbook(s): 1. Christopher M. Bishop, "Pattern Recognition and Machine Learning," Springer. 2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning," Springer. 3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow," 2nd Edition, O'Reilly Media.
Proposed Course Outcomes: At the end of the course, the students will be able to • INT3231.1: Implement and evaluate supervised learning algorithms. • INT3231.2: Apply unsupervised learning and dimensionality reduction techniques. • INT3231.3: Develop Bayesian models and handle practical issues. • INT3231.4: Construct and optimize ensemble models. • INT3231.5: Build and train neural networks using backpropagation.

INT3232 Compiler Design Lab [0 0 2 1]
Syllabus
Basic Concept: Identification of regular expression and string pattern, Automata Designing: Implementation of FA, PDA, TM for given languages, Context Free Grammar: Identification of left factoring and left recursion from given CFG. Lexical Analysis: Design and Implementation of Lexical Analyzer; Parsing: Design and Implementation of Parser, Implementation of Code Generator; LEX and YACC: Programs using LEX, Programs using YACC.
Proposed Text and Reference Book(s):



1. An Introduction to Formal Languages and Automata – Peter Linz, Jones and Bartlett Student Edition, Fifth Edition, 2010.
2. Compilers: Principles, Techniques and Tools – A. Aho, J. Ullman, M. S. Lam, R. Sethi, Pearson Education, 2nd Edition, 2007.
3. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, (2e), Pearson Education India, 2013

Proposed Course Outcomes:

At the end of the course the student will be able to

- INT3232.1: Identify string patterns from given input text.
- INT3232.2: Identify the type of a given grammar according to Chomsky Hierarchy of languages
- INT3232.3: Design and Implementation of different automata machines like Finite Automata, Push Down Automata, and Turing Machine.
- INT3232.4: Identify the behaviors of context free grammar say left recursive and left factored grammars from given CFG.
- INT3232.5: Demonstrate the use of LEX and YACC.

INT3270 Project Based Learning 4/Honors Project [0 0 6 3]

A student has to this course only if he is selected for Honors program. As part of this course a student must do a mini project of six credits under the guidance of an internal faculty mentor/guide (allocated by the department) of MUJ. The project work can be allocated by the faculty members or student can propose his/her own identified problem statement. The project can be an implementation-based coding project or a research-oriented work. At the end of the course, the student must demonstrate the executable working of project in case of a coding project or an outcome research-oriented project by submitting/publishing a paper either in a conference or in a journal of repute.

Proposed Course Outcomes:

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

- INT3270.1: Learn how to identify and define the requirements of a assigned problem.
- INT3270.2: Model, design and implement the solutions of a given or assigned problem.
- INT3270.3: Understand the importance of working in a team collaborative environment



Detailed Course Syllabus

Year: IV, Semester: 07

S.No	Course#	Course Name	L	T	P	C
1	INT41XX	Program Elective 7	3	0	0	3
2	INT41XX	Program Elective 8	3	0	0	3
3	INT4170	Internship (Industry / Research)	0	0	0	1
4	XXXXXX	Open Elective 4	3	0	0	3
5	XXXXXX	Open Elective 5	3	0	0	3
Total			12	0	0	13

Choices for Program Elective 7:

1. INT4140: Big Data Analytics
2. INT4141: Cloud Application Development
3. INT4142: Blockchain Technologies

Choices for Program Elective 8:

1. INT4143: Deep Learning
2. INT4144: Software Testing Techniques
3. INT4145: Natural Language Processing
4. INT4146: Image Processing
5. INT4147: Quantum Computing



INT4140 Big Data Analytics [3 0 0 3] (Program Elective -7)

Syllabus

Introduction to Big Data: Introduction, Distributed File System, Big Data and its Importance, Big Data Drivers, Big Data Applications; **Big Data Analytics:** Analyzing Big Data, Sources of Big Data, Characteristics of Big Data (10 V's), Types of Data, Structured vs. Unstructured vs. Semi structured Data, Data Marts, Differences Between Traditional DWDM and BDA, Limitations of Traditional RDBMS to Store and Analyses Big Data; **Data Scientists:** Key Competencies and Characteristics of Data Scientists, Data science, and Big Data, Data Wrangling, Data Mugging, Tutorial Based on Data Science Applications, Big Data Analytics Ecosystem; **State of the Practice in Analytics:** Data Analytics Lifecycle and Discussions, Roles for a Successful Analytics Project, Case Study to Apply the Data Analytics Lifecycle, Analytical Databases and DW Appliances; **Analyzing and Exploring the Data:** Hadoop Distributions – Comparing Various BDA Tools (Like Hadoop, MapReduce, Spark, Pig, Hive etc.), Challenges when Managing and Analyzing Big Data, The Role of Data Virtualization in a Big Data Environment, Big Data Platforms and Storage Options, The New Multi-Platform Analytical Ecosystem, **Analytical Databases:** Hadoop and NoSQL DBMS (Cassandra and MongoDB), Case Study Based Tutorial.

Proposed Text and Reference Book(s):

Text Book(s):

1. Bahga, Arshdeep and Vijay Madiseti, Big data science & analytics: A hands-on approach, (1e), VPT, 2016.
2. EMC Education Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, (1e), John Wiley & Sons, 2015.

Reference Books:

1. Minelli, Michael, Michele Chambers, and Ambiga Dhiraj. Big data, big analytics: emerging business intelligence and analytic trends for today's businesses, (1e), John Wiley & Sons, 2012.
2. Shankar VG and Devi B, Big Data Analytics - A Practical Approach, 1e, Walnut Publication, 2020.

Proposed Course Outcomes:

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

- INT4140.1: Understand the fundamentals of Big Data, including its importance, applications, and distributed file systems.
- INT4140.2: Analyse Big Data, distinguish between data types, and recognize the limitations of traditional RDBMS.
- INT4140.3: Identify key competencies of data scientists and apply data wrangling techniques in Big Data analytics.
- INT4140.4: Use Big Data tools (e.g., Hadoop, Spark) and understand analytical databases and platforms for effective data analysis.

INT4141 Cloud Application Development [3 0 0 3] (Program Elective -7)

Syllabus

Introduction, Contrast traditional software development and development for the cloud. Public v private cloud apps. Understanding Cloud ecosystems – what is SaaS/PaaS, popular APIs, mobile.

Class and Method design to make best use of the Cloud infrastructure; Web Browsers and the Presentation Layer: Understanding Web browsers attributes and differences. Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash.

Building Ajax controls, introduction to JavaScript using Query, working with JSON, XML, REST. Application development Frameworks e.g. Ruby on Rails, .Net, Java API's or JSF; Deployment Environments – Platform As A Service (PAAS), Amazon, vmForce, Google App Engine, Azure, Heroku, AppForce.

Backend application development with Node.js and Express. Develop front-end web interfaces with React.jsx and ES6. Developing and Deploying an Application in the Cloud : Building on the experience of the first project students will study the design, development, testing and deployment of an application in the cloud using a development framework and deployment platform.



The advances and the latest trends in the course as well as the latest applications of the areas covered in the course. The latest research conducted in the areas covered in the course. Discussion of some latest papers published in IEEE transactions and ACM transactions, Web of Science and SCOPUS indexed journals as well as high impact factor conferences as well as symposiums. Discussion on some of the latest products available in the market based on the areas covered in the course and patents filed in the areas covered in the course.

Proposed Text and Reference Book(s):

Text Book(s):

1. Chris Hay, Brian Prince, "Azure in Action" Manning Publications [ISBN: 978- 1935182481],2010.
2. Henry Li, "Introducing Windows Azure" Apress; 1 edition [ISBN: 978-1- 4302-2469-3],2009
3. Eugenio Pace, Dominic Betts, Scott Densmore, Ryan Dunn, Masashi Narumoto, MatiasWoloski, Developing Applications for the Cloud on the Microsoft Windows Azure Platform [ISBN: 9780735656062]

Reference Books:

1. Charles Severance, Using Google App Engine [ISBN: 978-0596800697]
2. Marinescu, "Cloud Computing: Theory and Practice", M K Publishers, 1st Edition, 2013.
3. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw-Hill, 1st Edition, 2009.

Proposed Course Outcomes:

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

- INT4141.1: Develop cloud based applications
- INT4141.2: To analyze and trouble shoot the problems while deploying application on cloud.
- INT4141.3: Use web application based technologies for developing application using cloud
- INT4141.4: Use public cloud like IBM Blue mix, Amazon AWS, Google cloud platform or Microsoft Azure for developing an application
- INT4141.5: Deploy the application on real cloud
- INT4141.6: Gain understanding of latest trends and research areas in the course

INT4142 BlockChain Technologies [3 0 0 3] (Program Elective -7)

Syllabus

Basic Cryptographic Primitives: Encryption and decryption, public-key cryptography, RSA, ECC, digital signature, Secure Hash Algorithms, SHA-256, Keccak, Properties of Hash Algorithm, Merkle Tree, Patricia Tree, Distributed Hash Table. **Introduction to Blockchain technology:** History of blockchain, elements of a blockchain, Features of a blockchain, Tiers of blockchain technology, Types of blockchain, Consensus in blockchain, Applications of blockchain, benefits and limitations of blockchain. **Bitcoin:** Overview of Bitcoin and its architecture, Bitcoin mining and proof-of-work, Bitcoin transactions and scripts, Bitcoin wallets and security. **Ethereum:** Introduction to Ethereum and smart contracts, Ethereum Virtual Machine (EVM), Solidity programming language, Decentralized applications (DApps) on Ethereum. **Blockchain Applications:** Blockchain applications in finance, supply chain, identity, and voting, Case studies of successful blockchain applications, Regulatory and legal challenges for blockchain applications. **Future of Blockchain Technology:** Emerging trends in Blockchain technology, DeFi (decentralized finance), NFTs (non-fungible tokens), Potential Impact of Blockchain technology on the global economy and Society.

Proposed Text and Reference Book(s):

1. Narayanan, Bonneau, Felten, Miller, and Goldfeder (2016), "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press (1st ed.), (ISBN: 9780691171692, pages: 336).
2. Imran Bashir (2018), "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing. (2nd ed.) (ISBN:9781788838672, pages: 625).
3. Modi, Ritesh. (2018) "Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain" (1st ed.). Packt Publishing Ltd. (ISBN: 9781788831383, pages: 376.).

Proposed Course Outcomes:

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

- INT4142.1: Recall the cryptographic primitives used in Blockchain technology.
- INT4142.2: Understand the basic concepts and applications of Blockchain technology.
- INT4142.3: Understand the basic concepts of Solidity programming language.
- INT4142.4: Design and develop smart contracts using the solidity programming language.



INT4143: DEEP LEARNING[3 0 0 3] (Program Elective -8)

Syllabus

Introduction To Deep Learning: History of Deep Learning, Deep Learning Success Stories, Mcculloch Pitts Neuron, Thresholding Logic, Perceptron's, Perceptron Learning Algorithm; Multi-Layer Network and Optimization Technique: Multilayer Perceptron's (Mlps), Representation Power of Mlps, Sigmoid Neurons, Gradient Descent, Feed Forward Neural Networks, Representation Power of Feed Forward Neural Networks Feed Forward Neural Networks, Back Propagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Adagrad, Rmsprop, Adam, Eigenvalues and Eigenvectors, Eigenvalue Decomposition, Basis; Dimension Reduction and Regularization: Principal Component Analysis and its Interpretations, Singular Value Decomposition Auto Encoders and Relation to Pca, Regularization in Auto Encoders, Denoising Auto Encoders, Sparse Auto Encoders, Contractive Auto Encoders Regularization: Bias Variance Tradeoff, L2 Regularization, Early Stopping, Dataset Augmentation, Parameter Sharing and Tying, Injecting Noise at Input, Ensemble Methods, Dropout Greedy Layer Wise Pre-Training, Better Activation Functions, Better Weight Initialization Methods, Batch Normalization Learning Vectorial Representations of Words; Convolutional Neural Networks: Lenet, Alexnet, Zf-Net, Vggnet, Googlenet, Resnet, Visualizing Convolutional Neural Networks, Guided Back Propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks; Recurrent Neural Networks: Back Propagation Through Time (Bptt), Vanishing and Exploding Gradients, Truncated Bptt, Gru, Lstms Encoder Decoder Models, Attention Mechanism, Attention Over Images.

Book References:

1. J.Patterson, A.Gibson, *Deep Learning*, (1e), O'Reilly Publication, 2018.
2. Goodfellow I., Bengio Y, *Deep Learning (Adaptive Computation and Machine Learning series)*, (1e), MIT Press, 2017.
3. Shai Shalev-Shwartz , Shai Ben-David, *Understanding Machine Learning: From Theory to Algorithms*, (3e), Cambridge University Press, 2015.

Proposed Course Outcomes:

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

- INT4143.1 Apply basic ANN model to solve simple pattern recognition problems
- INT4143.2 Demonstrate the multilayer ANN for solving complex machine learning problems using various learning algorithms
- INT4143.3 Describe and demonstrate the effectiveness and purpose of CNN and their variety
- INT4143.4 Describe and demonstrate the effectiveness and purpose of RNN

INT4144 Software Testing Techniques [3 0 0 3] (Program Elective -8)

Syllabus

Introduction to Software Testing: Importance of testing, Testing objectives and goals, Software testing lifecycle; **Testing Fundamentals:** Testing levels (unit, integration, system, acceptance), Testing types (functional, non-functional, regression, performance), Black-box vs. white-box testing; **Test Planning and Documentation:** Test plan development, Test strategy and approach, Test documentation (test cases, test scenarios, test scripts); **Test Case Design Techniques:** Equivalence partitioning, Boundary value analysis, Decision table testing, State transition testing; **Test Execution and Reporting:** Test execution process, Defect tracking and management, Test reporting and metrics; **Test Automation:** Introduction to test automation, Test automation frameworks (e.g., Selenium, Appium), Scripting languages for test automation (e.g., Python, Java); **Performance Testing:** Introduction to performance testing, Load testing, stress testing, and scalability testing, Performance metrics and analysis; **Software Quality Assurance:** Quality assurance processes, Quality standards and certifications (e.g., ISO, CMMI), Continuous integration and continuous testing.

Proposed Text and Reference Book(s):

Text Book(s):

1. "Foundations of Software Testing", Aditya P. Mathur, Pearson Education, 2nd Edition, 2013, ISBN-10: 8131794768, ISBN-13: 978-8131794760.

Reference Books:



1. “Software Testing: Principles and Practices”, Srinivasan Desikan and Gopalaswamy Ramesh, Pearson Education, 1st Edition, 2006, ISBN-10: 817758121X, ISBN-13: 978-8177581218.
2. “Testing Computer Software”, Cem Kaner, Jack Falk, and Hung Q. Nguyen, Wiley, 2nd Edition, 2000, ISBN-10: 8177220152, ISBN-13: 978-8177220155.
3. “The Art of Software Testing”, Glenford J. Myers, Corey Sandler, and Tom Badgett, Wiley, 3rd Edition, 2011, ISBN-10: 1118031962, ISBN-13: 978-1118031964.

Proposed Course Outcomes:

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

- INT4144.1: Understand the importance of software testing and articulate its objectives and goals within the software development lifecycle.
- INT4144.2: Analyze various testing levels and types, differentiating between black-box and white-box testing methodologies.
- INT4144.3: Apply test case design techniques such as equivalence partitioning, boundary value analysis, decision table testing, and state transition testing to develop effective test cases.
- INT4144.4: Evaluate the effectiveness of test execution processes and test automation frameworks, utilizing performance testing metrics and quality assurance standards to ensure software quality.

INT4145 Natural Language Processing [3 0 0 3] (Program Elective -8)

Syllabus

Introduction to NLP: Human languages, models, ambiguity, processing paradigms: Understand the complexities and challenges in processing human languages, Explore different models and approaches to NLP. Phases in natural language processing, applications: Study the various phases involved in NLP from preprocessing to application. Discuss real-world applications of NLP. Text representation in computers, encoding schemes: Learn about different text encoding schemes (ASCII, UTF-8, etc.). **Linguistic Resources:** Introduction to corpus, elements in a balanced corpus: Understand the importance and structure of linguistic corpora. WordNet, VerbNet: Explore lexical databases like WordNet and Vernet. Recent developments in linguistic resources and datasets: New datasets and resources in NLP research. **Natural Language Grammars:** Lexeme, phonemes, phrases and idioms: Study the building blocks of language. Word order, agreement, tense, aspect, mood: Understand grammatical structures and their importance in NLP. Context-Free Grammar, spoken language syntax: Learn about CFGs and their application in NLP. **Part-of-Speech Tagging:** Stochastic POS tagging: Understand probabilistic approaches to POS tagging. Hidden Markov Models (HMMs). Transformation-based tagging (TBL): Study TBL for POS tagging. Handling of unknown words, named entities, multi-word expressions **Parsing:** Syntactic Parsing: Regular and Context-Free Languages, Context-Free Parsing: Understand different parsing techniques. Probabilistic Context-Free Grammars (PCFG), CKY Algorithm: Study probabilistic approaches and the CKY algorithm. Dependency Parsing: Dependency Grammar, Graph-based dependency parsing, Transition-based dependency parsing **Semantics: Meaning representation, semantic analysis:** Explore methods to represent and analyse meaning in text. Lexical semantics, WordNet: Study word meanings and relationships. Practical: Perform semantic analysis using WordNet. Recent trends in semantic analysis and understanding. **Language Modelling and Probabilistic Methods:** N-gram models, smoothing techniques (e.g., Laplace, Good-Turing): language models and smoothing techniques. Hidden Markov Models (HMMs) for language modelling: HMMs in the context of language modelling. Neural and pre-trained language models (e.g., BERT, GPT): Understand the role of neural networks in NLP. Advances in neural language modelling and transfer learning. **Applications of NLP:** Spell-checking, text summarization, machine translation: Study various applications of NLP. Sentiment analysis, question answering, chatbots: Understand how NLP is applied in these areas. Real-world applications and industry case studies.

Proposed Text and Reference Book(s):

Text Book(s):

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing,” 2nd edition, Pearson Education, 2009.

Reference Books:

1. C. Eugene, “Statistical Language Learning,” MIT Press, 1999.
2. T. Siddiqui and U. S. Tiwary, “Natural Language Processing and Information Retrieval,” Oxford University Press, 2008.
3. Yoav Goldberg, “Neural Network Methods for Natural Language Processing,” Morgan & Claypool Publishers, 2017.

Proposed Course Outcomes:



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

- INT4145.1: Describe the fundamental concepts and applications of NLP.
- INT4145.2: Implement text representation techniques and utilize linguistic resources.
- INT4145.3: Apply part-of-speech tagging, parsing, and semantic analysis techniques.
- INT4145.4: Develop language models using probabilistic methods and neural networks.
- INT4145.5: Apply NLP techniques to real-world applications and understand recent advancements in the field.

INT4146 Image Processing [3 0 0 3] (Program Elective -8)

Syllabus

Digital Image Fundamentals: Light and Electromagnetic Spectrum, Components of Image Processing System, Image Formation and Digitization Concepts, Neighbours of Pixel Adjacency Connectivity, Regions and Boundaries, Distance Measures, Applications of Image Processing in Industry **Image Enhancements in Spatial Domain:** Basic Gray Level Transformations, Histogram Processing, Using Arithmetic/Logic Operations, Smoothing Spatial Filters, Sharpening Spatial Filters, Machine Learning Techniques for Image Enhancement **Image Enhancements in Frequency Domain:** Introduction to The Fourier Transform and Frequency Domain Concepts, Smoothing Frequency-Domain Filters, Sharpening Frequency-Domain Filters, Advanced Frequency Domain Techniques **Image Restoration:** Various Noise Models, Image Restoration using Spatial Domain Filtering, Image Restoration using Frequency Domain Filtering, Estimating the Degradation Function, Inverse Filtering Deep Learning Approaches for Image Restoration **Colour Image Processing:** Colour Fundamentals, Colour Models, Colour Transformation, Smoothing and Sharpening, Colour Segmentation, Applications in Augmented and Virtual Reality **Image Compression:** Introduction Image Compression Model, Error-Free Compression, Lossy Compression, Modern Compression Techniques (e.g., JPEG 2000, WebP), Compression for Multimedia Applications **Image Segmentation:** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Machine Learning Techniques for Image Segmentation, Applications in Medical Imaging and Autonomous Vehicles **Image Representation and Description:** Boundary Descriptors, Region Descriptors, Feature Extraction, Image Representation in Machine Learning Models

Proposed Text and Reference Book(s):

Text Book(s):

1. Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Prentice Hall, 3rd edition, 2008.

Reference Books:

1. Milan Sonka, "Image Processing, analysis and Machine Vision", Thomson Press India Ltd, Fourth Edition.
2. Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.
3. S. Sridhar, Digital Image Processing, Oxford University Press, 2nd Ed, 2016.

Proposed Course Outcomes:

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

- INT4146.1: Describe the fundamental concepts of digital image processing and identify their applications in various industries.
- INT4146.2: Implement image enhancement and restoration techniques in both spatial and frequency domains using modern tools and software.
- INT4146.3: Apply machine learning techniques for image segmentation and enhancement, understanding their impact on the field.
- INT4146.4: Utilize advanced image compression methods and understand their relevance in multimedia applications.
- INT4146.5: Demonstrate practical skills in real-world applications such as augmented reality (AR), virtual reality (VR), medical imaging, and autonomous vehicles.



INT4147 Quantum Computing [3 0 0 3] (Program Elective -8)

Syllabus

Global perspectives: History of quantum computation and quantum information, Future directions Quantum bits: Multiple qubits, Quantum computation: Single qubit gates, Multiple qubit gates, Measurements in bases other than the computational basis, Quantum circuits, Qubit copying circuit?, Example: Bell states, Example: quantum teleportation, Quantum algorithms: Classical computations on a quantum computer, Quantum parallelism, Deutsch's algorithm, The Deutsch-Jozsa algorithm, Quantum algorithms summarized Experimental quantum information processing: The Stern-Gerlach experiment, Prospects for practical quantum information processing, Quantum information: Quantum information theory: example problems, Quantum information in a wider context, Linear algebra: Bases and linear independence, Linear operators and matrices, The Pauli matrices, Inner products, Eigenvectors and eigenvalues, Adjoint and Hermitian operators, Tensor products, Operator functions, The commutator and anti-commutator, The polar and singular value decompositions, The postulates of quantum mechanics: State space, Evolution, Quantum measurement, Distinguishing quantum states, Projective measurements, POVM measurements, Phase, Composite systems, Quantum mechanics: a global view.

Text and Reference Books:

Text Book:

- Michael A Nielsen, and Isaac L. Chuang "Quantum Computation & Quantum Information", (10e), Cambridge University Press, 2011..
- F. Benatti, M. Fannes, R. Floreanini, and D. Petritis, "*Quantum Information, Computation and Cryptography*" Springer, 2010

References:

1. Mika Hirvensalo, "*Quantum Computing*", (2e), Springer-Verlag New York, 2004.
2. Jozef Gruska, "*Quantum Computing*", McGraw Hill, 1999.
3. Phillip Kaye, Raymond Laflamme and Michele Mosca, "*An Introduction to Quantum Computing*", Oxford University Press, 2006

Proposed Course Outcomes:

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

- INT4147.1 Explain the basic Concepts of Quantum Computing like Quantum bits, superposition and gates.
- INT4147.2 Explain the difference between classic computing and quantum computing
- INT4147.3 Describe the various Quantum Computing Algorithms.
- INT4147.4 Describe the Postulates of Quantum Mechanics.
- INT4147. 5Apply the Linear Algebra in relation with quantum mechanics.

INT4170 Internship (Industry/Research) [0 0 0 1]

In this final year industrial training program, students apply theoretical knowledge to real-world problems in industry, institutions, and computer science research. Students use tools, programming languages, and design methodologies to follow the software development life cycle and apply numerous principles and practices learned from various topics. The documentation includes Software Requirements Specification, Modeling, and Testing Strategies. A committee of faculty members evaluates the projects internally, resulting in a thorough report and presentation before a panel of examiners, which marks the completion of academic activities.

Proposed Course Outcomes:

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

- [IT4170.1]: Apply the theoretical concepts learned in their coursework to real-world industrial scenarios. This outcome ensures that students can bridge the gap between academic learning and practical implementation in a professional setting.
- [IT4170.2]: Design and implement problems systematically, think critically, and devise innovative solutions, showcasing an ability to address complex challenges effectively.
- [IT4170.3]: Demonstrate proficiency in project management by creating plan, organize, and execute tasks efficiently, adhering to timelines and resource constraints. This outcome ensures that students are expected to gain practical experience in managing projects, from initiation to completion.



- [IT4170.4]: Collaborate proficiently within a team, exhibiting robust communication, cooperation, and leadership capabilities. Effectively allocate tasks and responsibilities among team members, showcasing adept teamwork.
- [IT4170.5]: Produce thorough project documentation adhering to industry-standard formats, encompassing design specifications, user manuals, and technical reports.
- [IT4170.6]: Exhibit ethical awareness and uphold ethical principles when managing sensitive data, guaranteeing data privacy, and respecting intellectual property rights.



Detailed Course Syllabus

Year: IV, Semester: 08

S.No	Course#	Course Name	L	T	P	C
1	INT4270	Major Project	0	0	0	12
Total			0	0	0	12

INT4270 Major Project [0 0 0 12]

The objective of the course is to allow the students to do an industry internship in an organization under the guidance of an industry expert (an official from the organization) and an allocated internal guide (allocated by the department) of MUJ. Alternatively, any student if interested can do either any research-oriented work or development-related work (that requires developing algorithms, coding and implementation) under the guidance of one or more faculty members. At the end of the course, a student has to submit a report that contains the details of the work, activities carried out by the student during that semester. The research project work can be allocated by the faculty members or student can propose his own identified problem statement. At the end of the course, the student has to demonstrate the whole carried-out work in whole semester in the form a presentation in front of the panel of examiners.

Proposed Course Outcomes:

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

- INT4270.1: Understand the structure and working environment of an organization.
- INT4270.2: Learn how to identify and define the requirements of an assigned problem.
- INT4270.3: Model, design and implement the solutions of a given or assigned problem.
- INT4270.4: Understand the importance of working in a team collaborative environment



Open Electives

INT0050 Java Programming Basics [3 0 0 3]

Introduction: Java program structure, Java Types, Java keywords, Java Constants, Java Methods; **Creating Objects:** Defining classes, role of private, public and protected attributes, Role of Constructors, role of static and final keywords; **Input/Output in Java:** Role of Scanner class, print() and println() Methods; **Strings and arrays in Java:** Defining 1-D, 2-D and Multi-Dimensional Arrays in Java, Basic String handling functions, Role of String Tokenizer class; **Polymorphism:** Method Overloading, Constructor Overloading, Examples; **Inheritance:** extending classes, abstract classes, abstract methods, role of extends clause; **Interfaces :** Role of interfaces in Java, class vs interface, defining interfaces, implementing interfaces; Exceptions in Java: Role of Exceptions, Writing Exceptions; role of try and catch blocks.

Proposed Text and Reference Book(s):

1. Herbert Schildt, "Java The Complete Reference", McGraw-Hill Education, 13th Edition, 2024, ISBN-10 : 9355326475, ISBN-13 : 978-9355326478.
2. E. Balagurusamy, "Programming with Java", McGraw-Hill, Standard Edition, 2023, ISBN-10 : 9355325894, ISBN-13 : 978-9355325891.

Proposed Course Outcomes: At the end of the course, the student will be able to

- INT0050.1: Learn how to compile and execute a simple Java program.
- INT0050.2: Understand the role of encapsulation and polymorphism in real world applications
- INT0050.3: Understand the importance of inheritance and exceptions in real-world applications.

Associated Coursera Course Details

1. Name of the Coursera Course: Introduction to Java
2. Institution Providing the Course: LearnQuest
3. Link: <https://www.coursera.org/learn/java-introduction>

INT0051 Introduction to AI [3 0 0 3]

Artificial Intelligence: Introduction to Artificial Intelligence, Current Trends in AI, Intelligent Agents, Agent v/s Software Program, Classification of Agents, Working of an Agent, Single and Multi-Agent System, Performance Evaluation of Agents, Architecture of Intelligent Agents; **AI Problems:** Problem Space: Problem analysis; Problem Solving Techniques: Heuristic search Techniques; Game Playing: Min Max Algorithm, alpha beta pruning; **Knowledge Representation:** Propositional and Predicate Calculus, Semantics for Predicate Calculus, Theorem Prover, Inference Rules, Unification, Resolution, Refutation in Predicate Logic;; **Learning Fundamentals:** Supervised learning (Basics of Classification and Regression), Unsupervised learning (Basics of Clustering and Association), Reinforcement Learning,

Text Books:

- [1] Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.
- [2] Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill, 2008
- [3] Vinod Chandra SS, Anand Hareendran S, "Artificial and Machine Learning", First Edition, PHI Learning, 2014.

- INT0051.1: Discuss basics of Artificial intelligence and some representative applications of artificial intelligence.
- INT0051.2: Formalise a given AI problem and analyse it along different dimensions.
- INT0051.3: Identify and implement appropriate A.I. search technique to solve the problem.
- INT0051.4: Illustrate knowledge representation using propositional, first order predicate logic and apply reasoning process to draw conclusions.



INT0052 Revised Syllabus of Linux Fundamentals [3 0 0 3]

UNIX System Overview, Program and Processes, Error Handling, User Identification, Signals, System Calls and Library Functions; File I/O: File Descriptors, Function for File Modification, I/O Efficiency, File Sharing, Atomic Operations; Directories: Stat, Fstat and Lstat Functions, File Types, Set-User-ID and Set-Group-ID, File Access Permissions, Function for modifying file permission and ownership, Symbolic Links; Unit2: Configuring Networks and Administering User Groups: Network Configuration Files, Command Line Network Configuration Basic Network Troubleshooting, Advanced Network Troubleshooting, Linux Users, Linux User Groups, User Configuration, Query User Information; Managing Disk Storage and Software Packages: Hard Drives, Partitions, Linux File Systems, Linux File Systems Management, Linux File Systems Monitoring, Open-Source Packages, Software Packages, Software Repositories;

References:

1. W.R. Steven, S. Rago, "Advanced Programming in the Unix environment", Addison Wesley, 2013.
2. S. Das, "Unix: Concepts and Applications", TMH Publications, 2017.

Proposed Course Outcomes:

At the End of the Course, a student will be able to

- INT0052.1 Learn the basic structure, commands and functions of Linux Operating System.
- INT0052.2 Learn the basic file handling and directory commands of Linux
- INT0052.3 Learn how manage user and storage management in Linux

INT0053 Basics of Cloud Computing [3 0 0 3]

Syllabus:

Introduction to Cloud Computing, Cloud issues and challenges - Properties - Characteristics Deployment models (Private, Public, Hybrid), Data-storage, Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services, Database as a Services, Anything / Everything as a service (XaaS), Function as a service, Security as a Service, Virtualization concepts, Benefits, Virtualization Structures, Full Virtualizations, Para Virtualization, Virtualization of CPU, Memory and I/O devices, Hypervisors, Cloud Infrastructure Framework, Physical and Virtual Infrastructure, Processes in Cloud Service Management, Role of Cloud Architect. Cloud Integration and Federation, Classic data Center – Application, DBMS, Compute, Storage, Redundant Array of Independent Disks, RAID Techniques, RAID level, Intelligent Storage System, Compute to compute communication, Compute to storage communication, Direct Attached Storage (DAS), Fibre Channel SAN (FC-SAN), FC SAN Addressing, Zoning, Storage Networking Technologies, capacity management, Performance management, Case Study with examples.

Text and Reference book(s):

1. Josyula, Venkata, Malcolm Orr, and Greg Page. *Cloud computing: Automating the virtualized data centre*, (1e), Cisco Press, 2011. ISBN No- 978-1587204340
2. Ray Rafaels. *Cloud computing*, (2e), CreateSpace Independent Publishing Platform, 2018. ISBN No- 978-1986726283
3. Buyya, Rajkumar, James Broberg, and Andrzej M. Goscinski, *Cloud computing: Principles and Paradigms*, (1e), John Wiley & Sons, 2010, ISBN No- 978-812654125

Proposed Course Outcomes:

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

- INT3140.1: Understand the basics of Cloud Computing.
- INT3140.2: Apply the principles of IAS, SAS, PAS to the cloud applications.
- INT3140.3: Develop a Cloud based application using Virtualization concepts.
- INT3140.4: Design and Implement Zoning concept using Storage Area Network.



[INT0054] Python Basics [3 0 0 3]

Python Concepts: Introduction to Python, Variables, Keywords, Identifiers, Literals, Operators, Comments; Control Statement: if, if else, else if, nested if, for loop, while loop, break, continue, pass; **Python OOPs:** OOPs Concepts, Object, Class, Constructors, Inheritance; **Functions:** Functions overview, lambda function, Recursive functions, map, filter and reduce. **Data structures:** List, Tuple, Set, Dictionary; File and Exception handling: Create a file, read and write operation with file, Introduction to Exceptions & Errors, Handling exceptions using try-except-else- finally.

Proposed Text and Reference Book(s):

1. Al Sweigart, "Automate the Boring Stuff with Python", William Pollock, 2015, ISBN: 978-1593275990.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015, ISBN: 978-9352134755.
3. Reema Thareja, "Python Programming using problem solving approach", Oxford University press, 2017. ISBN-13: 978-0199480173
4. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1 st Edition, Shroff Publishers, 2017. ISBN: 978-9352136278.

Proposed Course Outcomes: At the end of the course, the student will be able to

1. Write, Test and Debug Python Programs.
2. Interpret and illustrate data structures like list, tuple, set in python.
3. Synthesis of concepts and control structures of python.
4. Implement the concept of re-usability by means of functions as well as objects in python.

Associated Coursera Course Details

- INT0054.1: Name of the Coursera Course: **Programming for Everybody (Getting Started with Python)**
- INT0054.2: Institution Providing the Course: University of MICHIGAN
- INT0054.3: Link: <https://www.coursera.org/learn/python?specialization=python>

INT0055 Introduction to Data Analytics [3 0 0 3]

Introduction: Data Analytics tasks, Data Gathering and Preparation: Data Formats, Scalability and Real-time Issues; Essential Python Libraries **Data Cleaning:** Consistency Checking, Missing Data, Data Transformation **Exploratory Analysis:** Descriptive and comparative statistics, Statistical Inference. **Data Analysis Techniques:** Regression-Linear regression, multiple regression analysis, Classification techniques, Clustering, Association rules analysis; **Time Series Data Analysis:** Date and Time Data Types and Tools, Time series Basics, Type of Time Series, date Ranges, Frequencies and Shifting **Data Visualization matplotlib:** Basics of matplotlib, other python visualization tools. Case studies and application.

Proposed Text and Reference Book(s):

Text Book(s):

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc."

Reference Books:

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
2. E. Tufte. The Visual Display of Quantitative Information, (2e), Graphics Press, 2012.

Proposed Course Outcomes:



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

- INT0055.1: Apply data gathering and preparation techniques, considering scalability and real-time challenges in data analytics.
- INT0055.2: Demonstrate proficiency in data cleaning tasks, ensuring data consistency, handling missing data, and transforming data for analysis.
- INT0055.3: Analyse data through exploratory data analysis, utilizing techniques such as regression, classification, clustering, and association rule analysis.
- INT0055.4: Evaluate time series data and synthesize visualizations, applying these skills in case studies and real-world data analytics scenarios.

INT0056 Basics of Computer Networks [3 0 0 3]

Introduction to Computer Networks: Overview of computer networks, Importance of networking in modern computing, Types of networks (LAN, WAN, MAN). **Network Models:** Introduction to the OSI and TCP/IP models, Basic understanding of how data is transmitted in networks. **Network Devices:** Overview of key network devices like routers, switches, hubs, and access points, and their roles in a network. **Transmission Media:** Understanding wired (Ethernet cables, fiber optics) and wireless (Wi-Fi, Bluetooth) transmission media. **Introduction to Protocols:** Basics of network protocols, Overview of important protocols like HTTP, FTP, and DNS. **IP Addressing and Subnetting:** Basic concepts of IP addressing, the difference between IPv4 and IPv6, Simple exercises on IP addressing and subnetting. **Introduction to Network Security:** Basic concepts of network security, Common threats like viruses, malware, and phishing, Introduction to firewalls and antivirus software. **Basic Troubleshooting Techniques:** Simple troubleshooting techniques for common network issues, Introduction to network diagnostic tools like ping and tracert.

Proposed Text and Reference Book(s):

4. **Andrew S. Tanenbaum**, "Computer Networks," 5th Edition, Pearson.
5. **Behrouz A. Forouzan**, "Data Communications and Networking," 5th Edition, McGraw-Hill.
6. **James F. Kurose, Keith W. Ross**, "Computer Networking: A Top-Down Approach," 7th Edition, Pearson.

Proposed Course Outcomes: At the end of the course the student will be able to

- INT0056.1: Understand the basic concepts and importance of computer networks.
- INT0056.2: Identify different types of networks and the key components involved in network communication.
- INT0056.3: Demonstrate an understanding of network protocols and their role in data transmission.
- INT0056.4: Apply basic IP addressing and subnetting techniques.
- INT0056.5: Recognize common network security threats and apply basic security measures.

INT0057 Introduction to Data Structures [3 0 0 3]

Introduction: algorithm specification; **Performance analysis:** time and space complexity, asymptotic notation; **C concepts:** pointers, functions, arrays, passing arrays to functions through pointers, dynamic memory allocation, bubble sort, insertion sort, selection sort, structures, arrays of structures, passing structures to functions; **List:** ADT, array and its types, implementation, operations, linked list and its types, implementation and operations; **Stack:** ADT, implementations using array and linked list, operations and its applications; **Queue:** ADT, implementations using array and linked list, operations and its applications; **Tree:** terminologies, different types, representation of binary tree using array and linked structure, binary search tree, different operations (recursive and non-recursive), heap, heap sort, priority queue, AVL trees; **Graph:** Introduction, representation, operations and applications; **Searching techniques and hashing.**

Proposed Text and Reference Book(s):

Textbook (s):

1. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, "Data Structures using C", Pearson Education, 2013.



Reference Books:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", University Press (India) Pvt. Ltd., 2014.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2012.
4. Seymour Lipschutz, "Data Structures with C (Schaum's Outline Series)", McGraw Hill Education Private Limited, 2011.
5. Mark Allen Weiss, "Data structures and Algorithm Analysis in C", Pearson, Second edition, 2014.

Proposed Course Outcomes:

- INT0057.1: Understand the performance analysis of algorithms with their applications.
- INT0057.2: Illustrate basic concept of data structure operations such as traversing, insertion, deletion, searching and sorting.
- INT0057.3: Describe arrays, linked lists, stacks, queues, trees, and graphs are their representation in memory.
- INT0057.4: Perform various operations on different data structures and to solve real time problems.
- INT0057.5: Analyse and compare various searching and sorting algorithms, and assess the trade-offs involved in the design choices to develop employability skills.

INT0060: Python for Data Analytics [3 0 0 3]

Introduction to Python Programming: Basics of Python: Installation, Data Types, String and Arithmetic Operators. Data and Control Structures: Lists, Tuples, Sets, Dictionaries, Loops, Functions. OOP in Python: Objects, Methods, Class Inheritance, Overriding Basic Coding, Strings, Remove Duplicates, Balanced Brackets, Time Complexity, Searching, Sorting, Two Pointers, Recursion Python for Data Science: NumPy: Basics, 1-D and Multidimensional Arrays, Creating and Manipulating Arrays. Matplotlib: Visualization, Subplots. Pandas: Basics, Indexing and Slicing, Data frames, Grouping and Pivoting, Merge and Append Data Visualization in Python: Case Study: Analyzing Google Play store Ratings. Data Visualization with Seaborn: Distribution Plots, Styling Options, Different Types of Charts and Plots, Heatmaps, Plotly Movies Dataset Project: Find insights for some movies released between 1916 and 2016 by exploring a dataset of the same. Gather insights on entities such as actors, directors etc.

References

1. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython 2nd Edition by William McKinney (Author)
2. Automate the Boring Stuff with Python: Practical Programming for Total Beginners 1st Edition by Al Sweigart

Proposed Course Outcomes:

- INT0060.1: Understanding the basic concept and syntax of Python programming
- INT0060.2: Learning Python Language object-oriented concepts
- INT0060.3: Applying Python libraries such as NumPy, Matplotlib, and Pandas to manipulate, analyze, and visualize data
- INT0060.4: Analyzing data visualizations using Seaborn and Plotly