RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University, Chennai)
Choice Based Credit System (CBCS)
REGULATIONS – 2019
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
CURRICULUM AND SYLLABUS

Vision

To promote highly Ethical and Innovative Computer Professionals through excellence in teaching, training and research.

Mission

- To produce globally competent professionals, motivated to learn the emerging technologies and to be innovative in solving real world problems.
- To promote research activities amongst the students and the members of faculty that could benefit the society.
- To impart moral and ethical values in their profession.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To equip students with essential background in computer science, basic electronics and applied mathematics.

PEO 2: To prepare students with fundamental knowledge in programming languages, and tools and enable them to develop applications.

PEO 3: To encourage the research abilities and innovative project development in the field of AI, ML,DL, networking, security, web development, Data Science and also emerging technologies for the cause of social benefit.

PEO 4: To develop professionally ethical individuals enhanced with analytical skills, communication skills and organizing ability to meet industry requirements.

PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge: Apply the knowledge of Mathematics, Science, Engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

A graduate of the Artificial Intelligence and Machine Learning Program will demonstrate

PSO 1: Foundation Skills: Ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, web design, AI, machine learning, deep learning, data science, and networking for efficient design of computer-based systems of varying complexity. Familiarity and practical competence with a broad range of programming language, tools and open source platforms.

PSO 2: Problem-Solving Skills: Ability to apply mathematical methodologies to solve computational task, model real world problem using appropriate AI and ML algorithms. To understand the standard practices and strategies in project development, using open-ended programming environments to deliver a quality product.

PSO 3: Successful Progression: Ability to apply knowledge in various domains to identify research gaps and to provide solution to new ideas, inculcate passion towards higher studies, creating innovative career paths to be an entrepreneur and evolve as an ethically social responsible AI and ML professional.

CURRICULUM

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
Regulation 2019 | Total Credits: 166

SEMESTER I								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	HS19151	Technical English	HS	3	2	1	0	3
2.	MA19156	Linear Algebra and Calculus	BS	4	3	1	0	4
LAB ORIENTED THEORY COURSES								
3.	PH19241	Physics for Information Science	BS	5	3	0	2	4
4.	GE19141	Programming using C	ES	6	2	0	4	4
5.	GE19122	Engineering Practices- Electrical and Electronics	ES	2	0	0	2	1
NON CREDIT COURSES								
6.	MC19102	Indian Constitution and Freedom Movement	MC	3	3	0	0	0
			TOTAL	**23**	**13**	**2**	**8**	**16**

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SEMESTER II								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	MA19254	Probability and Inferential Statistics	BS	4	3	1	0	4
2.	GE19101	Engineering Graphics	ES	4	2	2	0	4
LAB ORIENTED THEORY COURSES								
3.	EE19242	Basic Electrical and Electronics Engineering	ES	5	3	0	2	4
4.	EC19243	Principles of Digital Electronics	ES	5	3	0	2	4
5.	CS19241	Data Structures	PC	7	3	0	4	5
LABORATORY COURSES								
6.	GE19121	Engineering Practices-Civil and Mechanical	ES	2	0	0	2	1
7.	CS19211	Python Programming Lab	PC	4	0	0	4	2
NON CREDIT COURSES								
8.	MC19101	Environmental Science and Engineering	MC	3	3	0	0	0
			TOTAL	**34**	**17**	**3**	**14**	**24**

SEMESTER III								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	MA19356	Discrete Mathematics for AI	BS	4	3	1	0	4
2.	GE19301	Life Science for Engineers	BS	3	3	0	0	3
3.	AI19301	Computer System Architecture	PC	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	CS19341	Design and Analysis of Algorithms	PC	5	3	0	2	4
5.	AI19341	Principles of Artificial Intelligence	PC	5	3	0	2	4
6.	AI19342	Object Oriented Programming using JAVA for AI	PC	7	3	0	4	5
NON CREDIT COURSES								
7.	MC19301	Essence of Indian Traditional Knowledge	MC	3	3	0	0	0
			TOTAL	**30**	**21**	**1**	**8**	**23**

SEMESTER IV								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.	MA19456	Optimization Techniques for AI	BS	4	3	1	0	4
LAB ORIENTED THEORY COURSES								
2.	AI19441	Web Development	PC	4	2	0	2	3
3.	AI19442	Fundamentals of Machine Learning	PC	5	3	0	2	4
4.	CS19443	Database Management Systems	PC	7	3	0	4	5
5.	IT19441	Operating System Design	PC	7	3	0	4	5
EMPLOYABILITY ENHANCEMENT COURSES								
6.	GE19421	Soft Skills I	EEC	2	0	0	2	1
			TOTAL	**29**	**14**	**1**	**14**	**22**

SEMESTER V								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-I	PE	3	3	0	0	3
2.		Open Elective – I	OE	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3.	AI19541	Fundamentals of Deep Learning	PC	5	3	0	2	4
4.	AI19542	Data Science using R	PC	5	3	0	2	4
5.	CS19541	Computer Networks	PC	7	3	0	4	5
6.	CB19342	Computational Statistics	BS	5	3	0	2	4
LABORATORY COURSES								
7.	AI19511	Mobile Application Development Laboratory for ML and DL Applications	PC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	GE19521	Soft Skills II	EEC	2	0	0	2	1
			TOTAL	**31**	**18**	**1**	**12**	**25**

SEMESTER VI								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-II	PE	3	3	0	0	3
2.	BA19602	Fundamentals of Accounting	HS	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
3.	AI19641	Computer Vision and its Applications	PC	5	3	0	2	4
4.	AI19642	Time Series Analysis and Forecasting	PC	5	3	0	2	4
5.	AI19643	Foundations of Natural Language Processing	PC	5	3	0	2	4
6.	AI19644	IoT Architecture and its Protocols	PC	5	3	0	2	4
EMPLOYABILITY ENHANCEMENT COURSES								
7.	AI19611	Mini Project	EEC	2	0	0	2	1
8.	GE19621	Problem Solving Techniques	EEC	2	0	0	2	1
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VII								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-III	PE	3	3	0	0	3
2.		Professional Elective-IV	PE	3	3	0	0	3
3.		Professional Elective-V	PE	3	3	0	0	3
4.	AI19701	Secure Systems Engineering	PC	3	3	0	0	3
5.	AI19702	Social and Ethical Issues in AI	PC	1	1	0	0	1
LAB ORIENTED THEORY COURSES								
6.	AI19741	Big Data Technology	PC	5	3	0	2	4
LABORATORY COURSES								
7.	AI19711	Project-I	EEC	6	0	0	6	3
			TOTAL	**24**	**16**	**0**	**8**	**20**

SEMESTER VIII								
SI. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY COURSES								
1.		Professional Elective-VI	PE	3	3	0	0	3
2.		Open Elective-II	OE	3	3	0	0	3
LABORATORY COURSES								
3.	AI19811	Project-II	EEC	12	0	0	12	6
			TOTAL	**18**	**6**	**0**	**12**	**12**

TOTAL NO. OF CREDITS: 166

PROFESSIONAL ELECTIVES (PE)

Elective – I								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P51	Knowledge Representation and Reasoning	PE	4	2	0	2	3
2.	AI19P52	AI for Game Programming	PE	4	2	0	2	3
3.	AI19P53	Mobile Technology	PE	3	3	0	0	3
4.	CS19P12	Distributed Systems	PE	4	2	0	2	3

Elective – II								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P61	GPU Programming	PE	4	2	0	2	3
2.	AI19P62	Data Analysis and Data Mining	PE	4	2	0	2	3
3.	CS19P06	Human Computer Interaction	PE	4	2	0	2	3
4.	CS19P09	C# and .Net Programming	PE	4	2	0	2	3

Elective – III								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P71	AI and Robotics	PE	4	2	0	2	3
2.	AI19P72	Data Visualization using Python	PE	4	2	0	2	3
3.	AI19P73	Innovation in Design Thinking for AI	PE	4	2	0	2	3
4.	IT19P77	Computational Linguistics	PE	3	3	0	0	3

Elective – IV								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P74	Foundations of Robotic Process Automation	PE	4	2	0	2	3
2.	AI19P75	Fuzzy Logic	PE	4	2	0	2	3
3.	IT19P76	Image processing & Vision Techniques	PE	3	3	0	0	3
4.	IT19P85	Social Networks	PE	3	3	0	0	3

Elective – V								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P76	Cyber Security Systems	PE	4	2	0	2	3
2.	AI19P77	Information Retrieval	PE	4	2	0	2	3
3.	AI19P78	Supply Chain Analytics	PE	3	3	0	0	3
4.	AI19P79	Hypothesis Testing	PE	4	2	0	2	3

Elective – VI								
SL. NO.	**COURSE CODE**	**COURSE TITLE**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1.	AI19P81	Network Analysis	PE	4	2	0	2	3
2.	AI19P82	Business Intelligence and Analytics	PE	4	2	0	2	3
3.	CB19P01	Quantum Computation and Quantum Information	PE	4	3	1	0	4
4.	IT19P84	Parallel Computing	PE	3	3	0	0	3

OPEN ELECTIVE COURSES OFFERED BY AIML

SL. NO.	COURSE CODE	COURSE TITLE	Category	Contact Periods	L	T	P	C
1.	OAI1901	Artificial Intelligence and Neural Network	OE	3	3	0	0	3
2.	OAI1902	Introduction to Machine Learning	OE	4	2	0	2	3
3.	OAI1903	Introduction to Robotic Process Automation	OE	3	3	0	0	3

SUMMARY OF ALL COURSES

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
S.NO	**Course Category**	**Credits per Semester**								**Total Credits**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	
1	HS	3					3			6
2	BS	8	4	7	4	4				27
3	ES	5	13							18
4	PC		7	16	17	14	16	8		78
5	PE					3	3	9	3	18
6	OE					3			3	6
7	EEC				1	1	2	3	6	13
8	MC	0	0	0						0
	Total	**16**	**24**	**23**	**22**	**25**	**24**	**20**	**12**	**166**

SEMESTER I

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
HS19151	TECHNICAL ENGLISH	HS	2	1	0	3

Objectives:	
●	To enable learners to acquire basic proficiency in English reading and listening.
●	To write in English precisely and effectively.
●	To speak flawlessly in all kinds of communicative contexts.

UNIT-I	VOCABULARY BUILDING	9
The concept of word formation – Root words from foreign languages and their use in English – Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives – Synonyms, antonyms, and standard abbreviations. Compound words – abbreviation – single word substitution – Listening: Listening comprehension, listening to motivational speeches, podcasts and poetry. Speaking: Short talks on incidents – place of visit – admiring personalities, etc.		
UNIT-II	**BASIC WRITING SKILLS**	**9**
Sentence structures – Use of phrases and clauses in sentences – punctuation – coherence – Organizing principles of paragraphs in documents – Techniques for writing precisely. **Reading & Writing** – Free writing – paragraphs – article reading and writing criticism – change of tense forms in short text or story – inferential reading – rewrite or interpret text – prepare questions based on the text. **Speaking:** Everyday situations – conversations and dialogues, speaking for and against.		
UNIT-III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Subject-verb agreement- Noun-pronoun agreement – Articles – Prepositions – Redundancies. Reading & Writing: Read from innovation and ideas that changed the world, newspaper column writing – Speaking: Demonstrative speaking practice using visual aids (charts, graphs, maps, pictures, etc.)		
UNIT-IV	**WRITING FOR FORMAL PRESENTATION**	**9**
Nature and Style of sensible Writing – Describing – Defining – Classifying – Providing examples or evidence – Writing introduction and conclusion. Reading & Writing – Read from Literary pieces – identify different parts text – Difference between print and digital writing. Writing: Recommendations – Foreword – Review of book. Speaking- Formal Presentations – Debate on social issues/taboos and solutions.		
UNIT-V	**EXTENDED WRITING AND SPEAKING**	**9**
Writing: Précis writing – Essay writing – workplace communication: Resume – Business letters and emails – Proposals. Speaking: Panel discussion – reporting an event – mock interview – Master Ceremony.		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course students will be able to	
●	Discuss and respond to the listening content.
●	Read and comprehend different texts and appreciate them.
●	Understand structures and techniques of precise writing.
●	Analyze different genres of communication and get familiarized with new words, phrases, and sentence structures.
●	Write and speak appropriately in varied formal and informal contexts.

Text Book(s):	
1	English for Technologists & Engineers, Orient BlackSwan Publications, Chennai, 2012.

Reference Books(s):	
1	Meenakshi Raman & Sangeeta Sharma, Technical Communication, Oxford University Press.
2	Bushan Kumar, Effective Communication Skills, Khanna Publishing House, Delhi.
3	Pushplata, Sanjay Kumar, Communication Skills, Oxford University Press.
4	Michael Swan, Practical English Usage, Oxford University Press, 1995.
5	F.T. Wood, Remedial English Grammar, Macmillan, 2007.
6	William Zinsser, On Writing Well, Harper Resource Book, 2001.
7	Liz Hamp-Lyons and Ben Heasly, Study Writing, Cambridge University Press, 2006.
8	Exercises in Spoken English, Parts I-III, CIEFL, Hyderabad, Oxford University Press.

CO – PO – PSO matrices of course

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
HS19151.1	1	-	-	-	-	-	1	-	2	3	1	3	-	2	-
HS19151.2	-	3	-	2	-	-	-	-	-	2	1	1	2	-	-
HS19151.3	-	-	-	1	-	-	-	-	-	3	-	-	2	-	-
HS19151.4	-	1	-	1	-	-	-	-	-	3	-	2	3	-	1
HS19151.5	1	1	1	1	1	1	1	1	2	3	1	1	1	-	-
AVERAGE	1.0	1.7	1.0	1.3	1.0	1.0	1.0	1.0	2.0	2.8	1.0	1.8	2.0	2.0	1.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MA19156	LINEAR ALGEBRA AND CALCULUS	BS	3	1	0	4

Objectives:	
●	To gain knowledge in using matrix algebra techniques and the concepts of basis and dimension in vector spaces.
●	To understand the techniques of calculus those are applied in the Engineering problems.

UNIT-I	MATRICES AND QUADRATIC FORMS	12
Symmetric and skew – symmetric matrices, Hermitian matrix, Unitary matrix and Orthogonal matrices – Eigen values and Eigen vectors – Cayley – Hamilton theorem (statement only) and applications – Similarity transformation – Orthogonal transformation and quadratic forms to canonical forms – Nature of quadratic forms.		
UNIT-II	**VECTOR SPACES**	**12**
Vector spaces – Subspaces – Linear combinations and system of Linear equations – Linear independence and Linear dependence – Bases and Dimensions – Linear Transformation – Matrix representation of Linear Transformation – Null space, Range and dimension theorem.		
UNIT-III	**INNER PRODUCT SPACES**	**12**
Inner product and norms – Gram Schmidt orthonormalization process – Modified Gram Schmidt orthonormalization process – QR Factorization-Singular value decomposition.		
UNIT-IV	**DIFFERENTIAL CALCULUS- FUNCTIONS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		
UNIT-V	**MULTIPLE INTEGRAL**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.		
	Total Contact Hours : 60	

Course Outcomes:	
On completion of the course students will be able to:	
●	Apply the concept of Eigen values and eigen vectors, diagonalization of a matrix for solving problems.
●	Use concepts of basis and dimension in vector spaces in solving problems.
●	Construct orthonormal basis using inner products and decompose matrices.
●	Analyze, sketch and study the properties of different curves and to handle functions of several variables and problems of maxima and minima.
●	Evaluate surface area and volume using multiple integrals.

Text Book(s):	
1	Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna Publishers, New Delhi, 2015.
2	Gilbert Strang, Introduction to linear algebra, 6th Edition, Wellesley Publishers, 2016

Reference Books(s):	
1	Friedberg, A.H., Insel, A.J. and Spence, L., Elementary Linear Algebra, a matrix approach, 2nd edition, Pearson, 2019.
2	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi, 2016.
3	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.
4	T Veerarajan, Engineering Mathematics –I, McGraw Hill Education, 2018
5	Ramana. B.V., Higher Engineering Mathematics, McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA19156.1	3	3	2	2	2	1	-	-	-	-	1	2	2	3	2
MA19156.2	3	3	2	2	2	1	-	-	-	-	1	2	3	3	2
MA19156.3	3	3	2	2	2	1	-	-	-	-	1	2	3	3	2
MA19156.4	3	3	2	2	3	1	-	-	-	-	1	2	2	3	2
MA19156.5	3	3	1	2	1	1	-	-	-	-	1	2	1	2	2
Average	3	3	1.9	2	2	1	-	-	-	-	1	2	2.2	2.8	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
PH19241	PHYSICS FOR INFORMATION SCIENCE	BS	3	0	2	4

Objectives:	
●	To understand the principles of laser and fibre optics in engineering and technology.
●	To understand the advanced concept of quantum theory and applications.
●	To study the properties and applications of semiconducting, magnetic, superconducting and optical materials.

UNIT-I	QUANTUM PHYSICS	9
Introduction- Quantum free electron theory-De Broglie's concept-Schrodinger wave equation-Time independent and time dependent equations-Physical significance of wave function – Particle in a one dimensional box – electrons in metals – degenerate states – Fermi – Dirac statistics – Density of energy states – Size dependence of Fermi energy – Quantum confinement – Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure – Band gap of nanomaterials.		
UNIT-II	**SEMICONDUCTOR PHYSICS**	**9**
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap – semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Carrier concentration in N-type and P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect.		
UNIT-III	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – carrier generation and recombination processes – Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) – photo current in a P-N diode – Photo transistor-solar cell – LED – Organic LED- Optical data storage techniques-Non Linear Optical materials-properties and applications.		
UNIT-IV	**LASERS AND FIBRE OPTICS**	**9**
Lasers: Population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction- Applications. Fiber optics: principle, numerical aperture and acceptance angle – types of optical fibers (material, refractive index, and mode) –Double crucible method-splicing technique- losses associated with optical fibers –Fiber optic communication system – fiber optic sensors: pressure and displacement.		
UNIT-V	**MAGNETIC AND SUPERCONDUCTING MATERIALS**	**9**
Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility –Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Domain Theory- M versus H 15ehavior – Hard and soft magnetic materials – examples and uses–Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor). Introduction of Superconductivity, Properties of Superconductors, BCS theory (Qualitative), Type-I and Type II Superconductors –Magnetic Levitation-SQUIDS- An overview of High temperature superconductors.		
	Contact Hours :	**45**

List of Experiments (Any 10 experiments)			
1	Determine the wavelength and angle of divergence of laser beam and numerical aperture using fiber cable.		
2	Determine the wavelength of spectrum by using spectrometer.		
3	Determine of refractive index of a given prism by using spectrometer.		
4	Determine specific resistance of the material of given wires using metre bridge.		
5	Verify Ohm's law – series and parallel.		
6	Determine the value of Planck's constant using photo electric effect.		
7	Determine the band gap of given semiconductor.		
8	Determination of Hall coefficient of semiconducting materials.		
9	Study the magnetic field produced by current carrying coils by using Helmoltz coil.		
10	Study the resonance frequency in series connected LCR circuits.		
11	Determine the wavelength of given source by using Newton's ring Experiment.		
12	Determine the thickness of the given specimen by using air wedge method.		
	Contact Hours	:	**30**
	Total Contact Hours	:	**75**
Course Outcomes:			

On completion of the course, the students will be able to:	
●	Apply the concepts of electron transport in nanodevices.
●	Analyze the physics of semiconductor devices
●	Analyze the properties of optical materials for optoelectronic applications.
●	Use the concepts of Laser and Fiber optics in communication.
●	Use the properties of magnetic and superconducting materials in data storage devices.

Text Book(s):	
1	Bhattacharya, D.K. & Poonam, T. Engineering Physics, Oxford University Press, 2015.
2	Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley 2012.
3	Kasap, S.O. Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
4	Kittel, C. Introduction to Solid State Physics, Wiley, 2005.

Reference Books(s):	
1	Garcia, N. & Damask, A., Physics for Computer Science Students, Springer Verlag, 2012.
2	Hanson, G.W. Fundamentals of Nanoelectronics, Pearson Education, 2009.
3	Rogers, B., Adams, J. & Pennathur, S. Nanotechnology: Understanding Small Systems, CRC Press, 2014.
4	S. O. Pillai, Solid state physics, New Age International, 2015.
5	Serway, R.A. & Jewett, J.W, Physics for Scientists and Engineers, Cengage Learning.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PH19241.1	3	3	2	2	2	1	-	1	1	2	1	2	1	1	2
PH19241 .2	3	3	3	2	3	1	1	-	1	2	1	2	1	1	2
PH19241 .3	3	3	3	2	3	1	1	-	1	2	1	2	1	1	1
PH19241 .4	3	3	2	2	3	1	1	-	1	2	1	2	1	-	1
PH19241 .5	3	3	2	2	3	1	1	-	1	2	1	2	1	1	1
Average	3.0	3.0	2.4	2.0	2.8	1.0	1.0	1.0	1.0	2.0	1.0	2.0	1.0	1.0	1.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
GE19141	PROGRAMMING USING C	ES	2	0	4	4

Objectives:	
●	To develop simple algorithms for arithmetic and logical problems.
●	To develop C Programs using basic programming constructs
●	To develop C programs using arrays and strings
●	To develop applications in C using functions, pointers and structures
●	To do input/output and file handling in C

UNIT-I	GENERAL PROBLEM SOLVING CONCEPTS	6
Computer – components of a computer system-Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.		
UNIT-II	**C LANGUAGE – TYPES OF OPERATOR AND EXPRESSIONS**	**6**
Introduction- C Structure- syntax and constructs of ANSI C – Variable Names, Data Type and Sizes, Constants, Declarations – Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation.		
UNIT-III	**I/O AND CONTROL FLOW**	**6**
Standard I/O, Formatted Output – Printf, Variable-length argument lists- Formatted Input – Scanf, Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, GoTo Labels.		
UNIT-IV	**FUNCTIONS AND PROGRAM STRUCTURE**	**6**
Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, C Pre-processor, Standard Library Functions and return types.		
UNIT-V	**POINTERS, ARRAYS AND STRUCTURES**	**6**
Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional arrays, Strings, Initialisation of Pointer Arrays, Command line arguments, Pointers to functions, complicated declarations. Basic Structures, Structures and Functions, Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, Bit-fields, File Access –Error Handling, Line I/O, Miscellaneous Functions.		
	Contact Hours : 30	

List of Experiments			
1	Algorithm and flowcharts of small problems like GCD.		
	Structured code writing with:		
2	Small but tricky codes		
3	Proper parameter passing		
4	Command line Arguments		
5	Variable parameter		
6	Pointer to functions		
7	User defined header		
8	Make file utility		
9	Multi file program and user defined libraries		
10	Interesting substring matching / searching programs		
11	Parsing related assignments		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**90**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Formulate simple algorithms for arithmetic and logical problems.
●	Implement conditional branching, iteration and recursion.
●	Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
●	Use arrays, pointers and structures to formulate algorithms and programs.
●	Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

Text Books:	
1	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Pearson Education India; 2nd Edition, 2015.
2	Byron Gottfried, Programming with C, Second Edition, Schaum Outline Series, 1996.

Reference Books:	
1	Herbert Schildt, C: The Complete Reference, Fourth Edition, McGraw Hill, 2017.
2	YashavantKanetkar, Let Us C, BPB Publications, 15th Edition, 2016.

Web links for virtual lab:	
1	https://www.tutorialspoint.com/compile_c_online.php
2	https://www.codechef.com/ide
3	https://www.jdoodle.com/c-online-compiler
4	https://rextester.com/l/c_online_compiler_gcc

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19141.1	1	2	2	2	1	-	-	-	1	2	1	1	2	3	-
GE19141.2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
GE19141.3	1	1	2	1	1	-	-	-	-	-	1	1	2	2	-
GE19141.4	2	2	3	2	1	-	-	-	1	-	2	1	2	2	2
GE19141.5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	2
Average	1.4	1.6	2.2	1.6	1.0	-	-	-	1.0	2.0	1.4	1.0	2.0	2.2	2.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE19122	ENGINEERING PRACTICES – ELECTRICAL AND ELECTRONICS	ES	0	0	2	1

Objectives:	
●	To provide hands on experience on various basic engineering practices in Electrical Engineering.
●	To impart hands on experience on various basic engineering practices in Electronics Engineering.

List of Experiments				
A. ELECTRICAL ENGINEERING PRACTICE				
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.			
2	Fluorescent lamp wiring.			
3	Stair case wiring.			
4	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.			
5	Measurement of resistance to earth of electrical equipment.			
B. ELECTRONICS ENGINEERING PRACTICE				
1	Study of Electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO.			
2	Study of logic gates AND, OR, XOR and NOT.			
3	Generation of Clock Signal.			
4	Soldering practice – Components Devices and Circuits – Using general purpose PCB.			
5	Measurement of ripple factor of HWR and FWR.			
	Total Contact Hours	**:**	**30**	

Course Outcomes:	
On completion of the course, the students will be able to	
●	Fabricate electrical and electronic circuits
●	Formulate the house wiring
●	Design the AC-DC converter using diode and passive components

REFERENCE	
1	Bawa H.S., Workshop Practice, Tata McGraw – Hill Publishing Company Limited, 2007.
2	Jeyachandran K., Natarajan S. &Balasubramanian S., A Primer on Engineering Practices Laboratory, Anuradha Publications, 2007.
3	Jeyapoovan T., Saravanapandian M. &Pranitha S., Engineering Practices Lab Manual,Vikas Publishing House Pvt.Ltd, 2006.
4	Rajendra Prasad A. &Sarma P.M.M.S., Workshop Practice,SreeSai Publication, 2002.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19122.1	3	3	3	3	3	1	1	-	2	1	3	3	-	-	-
GE19122.2	3	3	3	3	2	2	2	-	2	1	3	3	-	-	-
GE19122.3	3	3	3	3	3	1	1	-	2	1	3	3	-	-	-
Average	3	3	3	3	2.67	1.33	1.33	-	2	1	3	3	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC19102	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	3	0	0	0

Objectives:	
•	To inculcate the values enshrined in the Indian constitution
•	To create a sense of responsible and active citizenship
•	To know about Constitutional and Non- Constitutional bodies
•	To understand sacrifices made by the freedom fighters

UNIT-I	INTRODUCTION	9
Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens. Constitution meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.		
UNIT-II	**STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT**	**9**
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.		
UNIT-III	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOCALBODY**	**9**
State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts- Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Panchayat Raj: Introduction, Elected officials and their roles, ,Village level: Role of Elected and Appointed officials,		
UNIT-IV	**CONSTITUTIONAL FUNCTIONS AND BODIES**	**9**
Indian Federal System – Center – State Relations – President's Rule – Constitutional Functionaries – Assessment of working of the Parliamentary System in India- CAG, Election Commission, UPSC, GST Council and other Constitutional bodies-. NITI Aayog, Lokpal, National Development Council and other Non –Constitutional bodies.		
UNIT-V	**INDIAN FREEDOM MOVEMENT**	**9**
British Colonialism in India-Colonial administration till 1857- Revolt of 1857- Early Resistance to British Rule-Rise of Nationalism in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation Movement-Civil Disobedience Movement- Quit India Movement-British Official response to National movement- Independence of India Act 1947-Freedom and Partition.		
	Total Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
●	Understand the functions of the Indian government
●	Understand and abide the rules of the Indian constitution.
●	Gain knowledge on functions of state Government and Local bodies
●	Gain Knowledge on constitution functions and role of constitutional bodies and non-constitutional bodies
●	Understand the sacrifices made by freedom fighters during freedom movement

Text Book(s):	
1	Durga Das Basu, Introduction to the Constitution of India, Lexis Nexis, New Delhi., 21st edition, 2013.
2	BipanChandra,History of Modern India, Orient Black Swan, 2009.
3	Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016.
4	Maciver and Page, Society: An Introduction Analysis, MacMilan India Ltd., New Delhi.2nd edition, 2014.
5	P K Agarwal and K N Chaturvedi, PrabhatPrakashan Constitution of India, New Delhi, 1st edition, 2017.

Reference Books(s) / Web links:	
1	Sharma, Brij Kishore, Introduction to the Constitution of India, Prentice Hall of India, New Delhi.
2	U.R.Gahai, Indian Political System, New Academic Publishing House, Jalandhar.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC19102.1	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19102.2	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19102.3	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19102.4	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
MC19102.5	-	-	-	-	-	1	1	3	2	-	-	1	-	-	-
Average	-	-	-	-	-	1.0	1.0	3.0	2.0	-	-	1.0	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

SEMESTER II

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MA19254	PROBABILITY AND INFERENTIAL STATISTICS	BS	3	1	0	4

Objectives:	
●	To provide the required mathematical support in real life problems.
●	To gain knowledge of sampling techniques and use testing of hypothesis for parameter estimation.

UNIT-I	**ONE – DIMENSIONAL RANDOM VARIABLE**	**12**
Probability- Conditional Probability- Bayes Theorem-Discrete and continuous random variables – Moments – Moment generating function –Binomial, Poisson, Geometric, Uniform, Exponential, and Normal,Chi-square, t, F distributions.		
UNIT-II	**TWO – DIMENSIONAL RANDOM VARIABLES**	**12**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation andLinear regression- Multiple correlation and multiple regression–Applications of Central Limit Theorem.		
UNIT-III	**SAMPLING AND ESTIMATION THEORY**	**12**
Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling – Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.		
UNIT-IV	**TESTING OF HYPOTHESIS**	**12**
Statistical hypothesis – Large sample test based on Normal distribution for single mean and difference of means –Tests based on t, F and Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit.		
UNIT-V	**NON PARAMETRIC TESTS**	**12**
Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test.		
	Total Contact Hours : 60	

Course Outcomes: On completion of course students will be able to	
●	Apply the basic concepts of probability, one dimensional and two dimensional Random Variables.
●	Apply the concept of correlation and regression in real life situation.
●	Apply the concept of sampling distribution and estimation theory in forecasting.
●	Use the concepts of Testing of Hypothesis for industrial problems.
●	Use the concepts of Non Parametric Testing for Non-Normal Populations.

Text Book (s):	
1	Veerarajan T, 'Probability and Statistics, Random Processes and Queueing Theory', First edition, McGrawHill,2018.
2	I.R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, 8th Edition, 2015

Reference Books(s):	
1	Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2008.
2	Yates R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
3	D.C. Montgomery &E.Peck, Introduction to Linear Regression Analysis, 5th Edition, 2012.
4	A. Goon, M. Gupta and B. Dasgupta, Fundamentals of Statistics, vol. I & II, World Press, 2016
5	A.M. Mood, F.A. Graybilland D.C. Boes, Introduction to the Theory of Statistics, McGraw Hill Education.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA19254.1	3	3	2	2	1	1	-	-	-	-	1	2	1	2	1
MA19254.2	3	3	2	2	1	1	-	-	-	-	1	2	1	2	1
MA19254.3	3	3	2	2	2	1	1	-	-	-	2	2	2	3	2
MA19254.4	3	3	2	3	2	1	1	-	-	-	2	2	2	3	2
MA19254.5	3	3	2	3	2	1	1	-	-	-	2	2	2	3	2
Average	3	3	2	1.4	1.6	1	0.6	-	-	-	1.6	2	1.6	2.6	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
GE19101	ENGINEERING GRAPHICS	ES	2	2	0	4

Objectives:	
●	To understand the importance of the drawing in engineering applications
●	To develop graphic skills for communication of concepts, ideas and design of engineering products
●	To expose them to existing national standards related to technical drawings
●	To improve their visualization skills so that they can apply these skills in developing new products
●	To improve their technical communication skill in the form of communicative drawings

CONCEPTS AND CONVENTIONS (Not for Examination)			1
Importance of graphics in Engineering Applications–Use of drafting Instruments– BIS conventions and specifications– Size, layout and folding of drawing sheets– Lettering and dimensioning. Basic Geometrical constructions.			
UNIT-I	**PLANECURVES AND FREE HAND SKETCH**		**11**
Curves used in engineering practices: Conics–Construction of ellipse, parabola and hyperbola by eccentricity method– Construction of cycloids, Construction of involutes of square and circle drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects			
UNIT-II	**PROJECTION OFPOINTS, LINESAND PLANESURFACE**		**12**
Orthographic projection- principles-Principal planes- projection of points. First angle projection – Projection of straight lines inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method- Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.			
UNIT-III	**PROJECTIONOFSOLIDS**		**12**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.			
UNIT-IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENTOF SURFACES**		**12**
Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of the section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinders and cones.			
UNIT-V	**ISOMETRIC AND PERSPECTIVEPROJECTIONS**		**12**
Principles of isometric projection–isometric scale–Isometric projections of simple solids and truncated solids – Prisms, pyramids, cylinders and cones. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.			
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Construct different plane curves and free hand sketching of multiple views from pictorial objects.
●	Comprehend the theory of projection and to draw the basic views related to projection of points, lines and planes
●	Draw the projection of solids in different views
●	Draw the projection of Sectioned solids and development of surfaces of solids
●	Visualize and prepare Isometric and Perspective view of simple solids

Text Book (s):	
1	Bhatt N.D. and Panchal V.M., Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.
2	Natrajan K.V., A Text Book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2017.

Reference Books(s):	
1	Varghese P I., Engineering Graphics, McGraw Hill Education (I) Pvt.Ltd. 2013.
2	Venugopal K. and PrabhuRaja V., Engineering Graphics, New Age International (P) Limited, 2008.
3	Gopalakrishna K.R., Engineering Drawing, (Vol. I&II combined), Subhas Stores, Bangalore, 2017.
4	Basant Agarwal and Agarwal C.M., Engineering Drawing, McGraw Hill, New Delhi, 2018.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19101.1	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.2	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.3	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.4	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
GE19101.5	2	-	-	-	-	-	-	-	-	1	-	2	-	-	-
Average	2.0	-	-	-	-	-	-	-	-	1.0	-	2.0	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
EE19242	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	ES	3	0	2	4

Objectives:	
●	To introduce electric circuits and provide knowledge on the analysis of circuits using network theorems.
●	To impart knowledge on the phenomenon of resonance in RC, RL and RLC series and parallel circuits.
●	To provide knowledge on the principles of electrical machines and electronic devices.
●	To learn the concepts of different types of electrical measuring instruments and transducers.
●	To teach methods of experimentally analyzing electrical circuits, electrical machines, electronic devices and transducers.

UNIT-I	DC CIRCUITS	9
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems.		
UNIT-II	**AC CIRCUITS**	**9**
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections		
UNIT-III	**ELECTRICAL MACHINES**	**9**
Construction, Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines, three phase and single-phase induction motors.		
UNIT-IV	**ELECTRONIC DEVICES & CIRCUITS**	**9**
Types of Materials – Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias – Semiconductor Diodes –Bipolar Junction Transistor – Characteristics –Field Effect Transistors – Transistor Biasing – Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier.		
UNIT-V	**MEASUREMENTS & INSTRUMENTATION**	**9**
Introduction to transducers – Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect – Classification of instruments – PMMC and MI Ammeters and Voltmeters – Multimeter –Digital Storage Oscilloscope.		
	Contact Hours : 45	

List of Experiments			
1	Verification of Kirchhoff's Laws.		
2	Load test on DC Shunt Motor.		
3	Load test on Single phase Transformer.		
4	Load test on Single phase Induction motor.		
5	Characteristics of P-N junction Diode.		
6	Half wave and Full wave Rectifiers.		
7	Characteristics of CE based NPN Transistor.		
8	Inverting and Non- Inverting Op-Amp circuits.		
9	Characteristics of LVDT, RTD and Thermistor.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Analyse DC and AC circuits and apply circuit theorems.
●	Realize series and parallel resonant circuits.
●	Understand the principles of electrical machines.
●	Understand the principles of different types of electronic devices, electrical measuring instruments and transducers.
●	Experimentally analyze the electric circuits, electrical machines, electronic devices, and transducers.

Text Book(s):	
1	J.B.Gupta, Fundamentals of Electrical Engineering and Electronics,S.K.Kataria& Sons Publications, 2002.
2	D P Kothari and I.J Nagarath, Basic Electrical and Electronics Engineering, McGraw Hill Education (India) Private Limited, Third Reprint,2016
3	Thereja .B.L., Fundamentals of Electrical Engineering and Electronics, S. Chand & Co. Ltd., 2008

Reference Books(s):	
1	Del Toro, Electrical Engineering Fundamentals, Pearson Education, New Delhi, 2007
2	John Bird,Electrical Circuit Theory and Technology, Elsevier, First Indian Edition, 2006
3	Allan S Moris, Measurement and Instrumentation Principles, Elsevier, First Indian Edition, 2006
4	Rajendra Prasad, Fundamentals of Electrical Engineering, Prentice Hall of India, 2006
5	A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, Basic Electrical Engineering, McGraw Hill Education(India) Private Limited, 2009

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EE19242.1	2	2	2	3	3	2	1	-	-	-	-	3	2	2	2
EE19242.2	1	2	2	3	2	2	3	-	-	-	-	-	1	-	1
EE19242.3	2	3	2	1	2	2	2	-	2	-	-	1	2	2	2
EE19242.4	3	3	2	3	1	2	2	-	-	-	2	2	2	1	2
EE19242.5	3	3	2	2	2	1	2	1	2	1	2	1	2	3	2
Average	2.2	2.6	2.0	2.4	2.0	1.8	2.0	1.0	2.0	1.0	2.0	1.8	1.8	2.0	1.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
EC19243	PRINCIPLES OF DIGITAL ELECTRONICS	ES	3	0	2	4

Objectives:	
●	To learn the basic postulates of Boolean algebra and infer the methods for simplifying Boolean expressions
●	To understand the design of various Combinational circuits.
●	To extrapolate the design of Synchronous Sequential circuits using Flip-Flops.
●	To know the design procedure of Asynchronous Sequential circuits and its problems.
●	To understand the concept of Programmable Logic Devices for the design of digital circuits and Familiar with Verilog HDL.

UNIT-I	BOOLEAN ALGEBRA AND LOGIC GATES	9
Fundamentals: Boolean postulates and laws, De-Morgan's Theorem, Principle of Duality, Boolean expression, Minterm, Maxterm, Sum of Products (SOP), Product of Sums (POS). **Minimization Techniques:** Minimization of Boolean expressions using Boolean Laws, Karnaugh map, Quine McCluskey method of minimization, don't care conditions. Logic Gates: NAND– NOR implementations.		
UNIT-II	**COMBINATIONAL CIRCUITS**	**9**
Half adder, Full Adder, Half subtractor, Full subtractor, Carry Look Ahead adder, Parallel Binary Adder/Subtractor, BCD adder, Binary Multiplier, Parity generator, Parity checker, Magnitude Comparator, Encoder, Decoder, Multiplexer-Logic function implementation, Demultiplexer. Code converter- Binary to Gray and Gray to Binary		
UNIT-III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Memory elements: Latches, Flip-flops: RS, JK, D, T, Master-Slave, Triggering of Flip Flops, Realization of one flip flop using other flip flop. **Design:** Synchronous and Asynchronous counters – Up/Down counter, Modulo–N counter. Shift Registers – SISO, SIPO, PISO, PIPO, Universal Shift Registers. Shift Register Counters – Ring counter, Shift counter. Design of synchronous sequential circuits using Moore and Mealy model		
UNIT-IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Design and analysis of asynchronous sequential circuits using Fundamental and pulse mode, Problems in Asynchronous sequential Circuits- Races, Cycles and Hazards.		
UNIT-V	**PROGRAMMABLE LOGIC DEVICES**	**9**
Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA), Implementation of Combinational Logic Circuits using PROM, PLA, PAL. Implementation of basic combinational circuits using Verilog HDL.		
	Contact Hours :	**45**

List of Experiments			
1	Implementation of Binary to Gray and Gray to Binary code converters		
2	Logic function implementation of Multiplexer and De-multiplexer using logic gates.		
3	Implementation of SISO, SIPO, PISO and PIPO shift registers using Flip- Flop.		
4	Design and Implementation of 4-bit Asynchronous and BCD Synchronous counters.		
5	Implementation of Adder and Subtractor using Verilog HDL.		
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS ❖ IC Trainer Kit – 15 Nos ❖ Bread Boards – 15 Nos ❖ Ics each 50 Nos – 7400,7402, 7404, 7486, 7408, 7432, 7411, 74151, 74150, 7474, 7476 ❖ System with HDL			
	Contact Hours	:	**30**
	Total Contact Hours	:	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Simplify the Boolean expressions using basic postulates of Boolean algebra with suitable minimization techniques.
●	Design and Implement Combinational circuits.
●	Construct Synchronous Sequential circuits using Flip-Flops.
●	Design Asynchronous Sequential circuits and analyse its problems.
●	Implement digital circuits using Programmable Logic Devices and Familiar with Verilog HDL.

Text Books:	
1	Morris Mano & Michael D Ciletti, "Digital Design: With an Introduction to Verilog HDL, 5th Edition, Pearson Education ,2013.
2	Charles H.Roth. "Fundamentals of Logic Design", 7th Edition, Thomson Learning, 2014.

Reference Books:	
1	John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
4	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
5	Donald D.Givone, "Digital Principles and Design", TMH, 2003.

Web links for virtual lab:	
1	http://vlabs.iitkgp.ernet.in/dec/#

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
EC19243.1	2	2	1	2	2	-	-	-	-	-	-	1	1	2	-
EC19243.2	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.3	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
EC19243.5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
Average	1.2	1.2	1.8	1.2	1.2	-	-	-	-	-	-	1.6	1.6	2.0	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CS19241	DATA STRUCTURES	PC	3	0	4	5

Objectives:	
●	To apply the concepts of List ADT in the applications of various linear and nonlinear data structures.
●	To demonstrate the understanding of stacks, queues and their applications.
●	To analyze the concepts of tree data structure.
●	To understand the implementation of graphs and their applications.
●	To be able to incorporate various searching and sorting techniques in real time scenarios.

UNIT-I	LINEAR DATA STRUCTURES – LIST	9
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		
UNIT-II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	**9**
Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue –DEQUE –applications of queues.		
UNIT-III	**NON LINEAR DATA STRUCTURES – TREES**	**9**
Tree Terminologies- Binary Tree–Representation-Tree traversals – Expression trees – Binary Search Tree–AVL Trees –Splay Trees – Binary Heap – Applications.		
UNIT-IV	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**
Graph Terminologies – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Shortest path – Dijikstra's Algorithm – Minimum Spanning Tree- Prim's Algorithm.		
UNIT-V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Quick sort – Merge Sort. Hashing- Hash Functions –Collision resolution strategies- Separate Chaining – Open Addressing – Rehashing.		
	Contact Hours : 45	

List of Experiments			
1	Array implementation of Stack and Queue ADTs		
2	Array implementation of List ADT		
3	Linked list implementation of List, Stack and Queue ADTs		
4	Applications of List, Stack and Queue ADTs		
5	Implementation of Binary Trees and operations of Binary Trees		
6	Implementation of Binary Search Trees		
7	Implementation of AVL Trees		
8	Implementation of Heaps using Priority Queues		
9	Graph representation and Traversal algorithms		
10	Applications of Graphs		
11	Implementation of searching and sorting algorithms		
12	Hashing –any two collision techniques		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**105**

Course Outcomes: On completion of the course, the students will be able to	
●	Analyze the various data structure concepts.
●	Implement Stacks and Queue concepts for solving real-world problems.
●	Analyze and structure the linear data structure using tree concepts.
●	Critically Analyse various non-linear data structures algorithms.
●	Apply different Sorting, Searching and Hashing algorithms.

Text Books:	
1	Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2002.
2	ReemaThareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.

Reference Books:	
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest and Clifford Stein, Introduction to Algorithms, Second Edition, McGraw Hill, 2002.
2	Aho, Hopcroft and Ullman,Data Structures and Algorithms, Pearson Education, 1983.
3	Stephen G. Kochan, Programming in C, 3rd edition, Pearson Education.
4	Ellis Horowitz, SartajSahni and Susan Anderson Freed,Fundamentals of Data Structures in C, 2ndEdition, University Press, 2008.

Web links for virtual lab (if any)	
1	http://vlabs.iitb.ac.in/vlab/labscse.html

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS19241.1	1	2	1	2	1	-	-	-	-	-	-	1	1	2	-
CS19241.2	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.3	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.4	1	1	2	1	1	-	-	-	-	-	-	2	2	2	-
CS19241.5	1	1	2	1	1	-	-	-	-	-	-	1	1	2	-
Average	1.0	1.2	1.8	1.2	1.0	-	-	-	-	-	-	1.6	1.6	2.0	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
GE19121	ENGINEERING PRACTICES – CIVIL & MECHANICAL	ES	0	0	2	1

Objectives:
• To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments				
CIVIL ENGINEERING PRACTICE				
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.			
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.			
3.	Hands-on-exercise: Basic pipe connections –Pipe connections with different joining components.			
Carpentry Works:				
4.	Study of joints in roofs, doors, windows and furniture.			
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiseling.			
MECHANICAL ENGINEERING PRACTICE				
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.			
7.	Gas welding practice.			
Basic Machining:				
8.	Simple Turning and Taper turning			
9.	Drilling Practice			
Sheet Metal Work:				
10.	Forming & Bending:			
11.	Model making – Trays and funnels			
12.	Different type of joints.			
Machine Assembly Practice:				
13.	Study of centrifugal pump			
14.	Study of air conditioner			
	Total Contact Hours	**:**	**30**	

Course Outcomes: On completion of the course, the students will be able to	
●	Perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
●	Perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
●	Produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
●	Perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
●	Perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19121.1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
GE19121.2	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
GE19121.3	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
GE19121.4	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
GE19121.5	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-
Average	-	-	-	-	-	-	-	1.0	1.0	-	-	-	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
CS19211	PYTHON PROGRAMMING LAB	PC	0	0	4	2

Objectives:	
●	Learn the Python Environment using interactive and script mode
●	Implement Python programs with conditionals and loops.
●	Use functions for structuring Python programs.
●	Represent compound data using Python lists, tuples and dictionaries.
●	Read and write data from/to files in Python.

List of Experiments			
1	Implement simple python programs using interactive and script mode.		
2	Develop python programs using id() and type() functions		
3	Implement range() function in python		
4	Implement various control statements in python.		
5	Develop python programs to perform various string operations like concatenation, slicing, Indexing.		
6	Demonstrate string functions using python.		
7	Implement user defined functions using python.		
8	Develop python programs to perform operations on list		
9	Implement dictionary and set in python		
10	Develop programs to work with Tuples.		
11	Create programs to solve problems using various data structures in python.		
12	Implement python program to perform file operations.		
13	Implement python programs using modules and packages.		
14	Mini Project		
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Run Python Programs at interactive and script mode.
●	Implement Python programs with conditionals and loops.
●	Develop Python programs stepwise by defining functions and calling them.
●	Use Python lists, tuples and dictionaries for representing compound data.
●	Read and write data from/to files in Python

Web links for virtual lab	
1	https://www.python.org/shell/
2	https://www.tutorialspoint.com/execute_python_online.php
3	https://www.onlinegdb.com/

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS19211.1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CS19211.2	1	1	1	1	1	-	-	-	-	-	1	1	2	2	-
CS19211.3	2	2	3	2	1	-	-	-	1	-	2	1	2	2	-
CS19211.4	1	1	2	1	1	-	-	-	-	-	1	1	2	2	-
CS19211.5	2	2	3	2	1	-	-	-	-	-	2	1	2	2	-
Average	1.5	1.5	2.3	1.5	1.0	-	-	-	1.0	-	1.5	1.0	1.8	1.8	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC19101	ENVIROMENTAL SCIENCE AND ENGINEERING	MC	3	0	0	0

Objectives:	
●	To understand the importance of natural resources, pollution control and waste management.
●	To provide the students awareness on the current social issues and environmental legislations.

UNIT-I	NATURAL RESOURCES	9
Environment –definition – scope and importance – forest resources –use and overexploitation –water resources –use and over utilization – dams – benefits and problems – water conservation –energy resources – growing energy needs – renewable and non-renewableenergy sources – use of alternate energy sources –land resources –land degradation – role of an individual in conservation of natural resources		
UNIT-II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – causes, effects and control measures of air pollution –chemical and photochemical reactions in the atmosphere – formation of smog, PAN, acid rain, and ozone depletion- noise pollution –mitigation procedures – control of particulate and gaseous emission (Control of SO2, NOX, CO and HC). Water pollution – definition-causes-effects of water pollutants–marine pollution-thermal pollution-radioactive pollution-control of water pollution by physical, chemical and biological processes–waste water treatment-primary, secondary and tertiary treatment. Soil pollution: definition-causes-effects and control of soil pollution.		
UNIT-III	**SOLID WASTE MANAGEMENT**	**9**
Solid wastes – sources and classification of solid wastes –solid waste management options – sanitary landfill, recycling, composting, incineration, energy recovery options from wastes. Hazardous waste –definition –sources of hazardous waste-classification (biomedical waste, radioactive waste, chemical waste, household hazardous waste)-characteristics of hazardous waste ignitability (flammable) reactivity, corrosivity, toxicity –effects of hazardous waste –case study-Bhopal gas tragedy – disposal of hazardous waste-recycling , neutralization, incineration, pyrolysis, secured landfill – E-waste management –definition-sources-effects –electronic waste recycling technology.		
UNIT-IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**9**
Sustainable development –concept, components and strategies – social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine – consumerism and waste products – environment and human health – role of information technology in environment and human health –disaster management– floods, earthquake, cyclone and landslide.		
UNIT-V	**TOOLS FOR ENVIRONMENTAL MANAGEMENT**	**9**
Environmental impact assessment (EIA) structure –strategies for risk assessment–EIS-environmental audit-ISO 14000-precautionary principle and polluter pays principle- constitutional provisions- - pollution control boards and pollution control acts- environmental protection act1986- role of non-government organizations- international conventions and protocols.		
	Total Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Be conversant to utilize resources in a sustainable manner.
●	Find ways to protect the environment and play proactive roles.
●	Apply the strategies to handle different wastes
●	Develop and improve the standard of better living.
●	Be conversant with tools of EIA and environmental legislation.

Text Book(s):	
1	Benny Joseph, "Environmental Science and Engineering", 2nd edition, Tata McGraw-Hill, New Delhi, 2008.
2	Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2ndedition, Pearson Education, 2004.

Reference Books(s):	
1	Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt. Ltd, New Delhi, 2007.
2	ErachBharucha, "Textbook of Environmental Studies", 3rd edition, Universities Press, 2015.
3	G. Tyler Miller and Scott E. Spoolman, "Environmental Science", 15thedition,CengageLearning India, 2014.
4	Rajagopalan, R, "Environmental Studies-From Crisis to Cure", 3rdedition, Oxford UniversityPress, 2015.
5	De. A.K., "Environmental Chemistry", New Age International, New Delhi, 1996.
6	K. D. Wager, "Environmental Management", W. B. Saunders Co., USA, 1998.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC19101.1	3	2	3	2	1	3	3	2	1	1	1	1	1	1	1
MC19101.2	3	3	3	2	2	3	3	3	2	1	2	2	1	2	2
MC19101.3	3	3	3	2	2	3	3	3	2	1	2	1	1	2	1
MC19101.4	3	3	3	2	2	3	3	2	2	1	2	2	1	2	2
MC19101.5	2	2	3	1	1	3	3	1	1	2	1	1	1	1	1
Average	2.8	2.6	3.0	1.8	1.6	3.0	3.0	2.2	1.6	1.2	1.6	1.4	1.0	1.6	1.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

SEMESTER III

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MA19356	DISCRETE MATHEMATICS FOR AI	BS	3	1	0	4

Objectives:	
●	To extend student's Logical and Mathematical maturity and ability to deal with abstraction.
●	To study various enumeration methods using principle of counting.
●	To understand various algebraic structures.
●	To obtain knowledge of discrete structures involving graphs.
●	To obtain knowledge of discrete structures involving trees.

UNIT-I	MATHEMATICAL LOGIC	12
Propositional calculus – propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility – natural deduction system and axiom system; Soundness and completeness.		
UNIT-II	**COMBINATORICS**	**12**
Basic counting sum and product, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.		
UNIT-III	**STRUCTURED SETS**	**12**
Set, relation – Algebraic System : Groups, Semi groups, monoid, homomorphism, cosets, Ring and Field (definition), Relation, Equivalence relations, Poset, Lattices, Hasse diagram, Boolean algebra.		
UNIT-IV	**GRAPH THEORY**	**12**
Introduction – Graph Terminologies – Types of Graphs – Sub Graph- Multi Graph – Regular Graph – Isomorphism – Isomorphic Graphs – Sub-graph – Euler graph – Hamiltonian Graph – Related problems.		
UNIT-V	**TREES**	**12**
Trees –Properties- Distance and Centres – Types – Rooted Tree—Tree Enumeration Labeled Tree – Unlabeled Tree – Spanning Tree – Fundamental Circuits- Cut Sets – Properties – Fundamental Circuit and Cut-set- Connectivity- Separability – Related problems.		
	Total Contact Hours : 60	

Course Outcomes: On completion of the course, the students will be able to	
●	Apply the concepts of logic to test the validity of a program and to arrive at inferences on logical structures.
●	Use the counting principles in implementing various programmes.
●	Analyze sets with operations and conclude the properties about the structures.
●	Handle a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
●	Apply suitable graph model and algorithm for solving applications.

Text Book(s):	
1	Digital Logic & Computer Design, M. Morris Mano, Pearson India Educations Services Pvt. Ltd 2016.
2	Elements of Discrete Mathematics, (Second Edition) C. L. Liu McGraw Hill, New Delhi, 2017.

Reference Books(s):	
1	Introduction to linear algebra. Gilbert Strang Fifth Edition (2016).
2	Introductory Combinatorics, R. A. Brualdi, Fifth Edition, Pearson Education Inc. (2010).
3	Graph Theory with Applications to Engineering and Computer Science, N. Deo, Prentice Hall, Englewood Cliffs Dover edition, (2016).
4	Introduction to Mathematical Logic,(Sixth Edition), E. Mendelsohn, CRC press Taylor & Francis group, (2015).
5	Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London, Fifth Printing, (1982).
6	Mathematical Logic for Computer Science,L. Zhongwan, World Scientific Publishing Co. Pte. Ltd., Singapore, (1998).
7	Topics in Algebra, I. N. Herstein, John Wiley and Sons, (1975).

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA19356.1	3	3	2	3	-	-	-	-	-	-	-	2	3	3	2
MA19356.2	3	3	2	3	-	-	-	-	-	-	-	2	3	3	2
MA19356.3	3	3	2	3	-	-	-	-	-	-	-	2	2	3	1
MA19356.4	3	3	3	3	2	-	-	-	-	-	2	2	3	3	1
MA19356.5	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
Average	3	3	2.4	3	2	-	-	-	-	-	2	2	2.8	3	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
GE19301	LIFE SCIENCE FOR ENGINEERS	BS	3	0	0	3

Objectives:	
●	Broad objective of this course is to give an introduction of life science to engineering students.
●	The course helps students to familiarize with human physiology, life style diseases and their management and basic diagnostic aspects.

UNIT-I	**OVERVIEW OF CELLS AND TISSUES**	**9**
Introduction to Bacteria, virus, fungi and animal cells. Organisation of cells into tissues and organs. Functions of vital organs.		
UNIT-II	**HEALTH AND NUTRITION**	**9**
Balanced diet, Importance of RDA, BMR, and diet related diseases. Role of antioxidants PUFA, DHA, Essential amino acids, Essential fatty acids in diet. Water and its significance for human health. Physical and Mental health – Significance of exercise and yoga.		
UNIT-III	**UNHEALTHY PRACTICES AND THEIR IMPACT ON HEALTH**	**9**
Drug induced toxicity, Unhealthy practices – Drug abuse/Narcotics/Smoking/Alcohol/Self-medication/Undue usage of electronic gadgets.		
UNIT-IV	**COMMON DISEASES AND LIFESTYLE DISORDERS**	**9**
Prevention and management of food, water and airborne illness (Common cold, dehydration, food poisoning etc). Lifestyle disorders – obesity, diabetes, stroke, heart attack, ulcer, renal calculi, cancer, AIDS, hepatitis- prevention and management.		
UNIT-V	**DIAGNOSTIC TESTS AND THEIR RELEVENCE**	**9**
Normal range of biochemical parameters, significance of organ function tests, organ donation.		
	Total Contact Hours :	**45**

Course Outcomes: On completion of the course, the students will be able to	
●	Classify the living organisms and relate the functions of vital organs
●	Demonstrate the importance of balanced diet and plan methods for healthy living
●	Analyse the hazards of unhealthy practices and take preventive measures
●	Categorise the various life style disorders and recommend ways to manage the common diseases
●	Evaluate and interpret biochemical parameters and their significance

Text Book(s):	
1	Carol D. Tamparo PhD CMA-A (AAMA), Marcia (Marti) A. Lewis EdD RN CMA-AC (AAMA), “Diseases of human body , F.A Davis Company, 2011.
2	Textbook of Medical Biochemistry, Chatterjea and Rana shindae Jaypee Brothers Medical Publishers, 2011.

Reference Books(s):	
1	ArthurT.Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2011.
2	Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, “Cell Biology and Genetics”, Cengage Learning, 2008.

Web link:	
1	https://nptel.ac.in/courses/122103039/

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
GE19301.1	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2
GE19301.2	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2
GE19301.3	3	1	2	2	2	3	1	3	1	2	1	3	3	1	2
GE19301.4	3	1	2	2	2	3	1	1	1	2	1	3	3	1	2
GE19301.5	3	1	2	2	3	3	1	1	1	2	1	3	3	1	2
Average	3	1	2	2	2.2	3	1	1.4	1	2	1	3	3	1	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
AI19301	COMPUTER SYSTEM ARCHITECTURE	PC	3	0	0	3

Objectives:	
●	To understand the structure, function and characteristics of computer systems.
●	To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
●	To make the students quantitatively evaluate simple computer designs and their sub-modules.
●	To explain the function of each element of a memory hierarchy.
●	To expose and make the students to learn about the memory system design and different ways of communicating with I/O devices and standard I/O interfaces..

UNIT-I	INTRODUCTION	9
Introduction –RISC – CISC, Eight ideas – Components of a computer system – Technology – Performance – Power wall –Instructions – Operations & Operands, Representing instructions, Logical operations – Instructions for decision making- Addressing Modes. Case Study: Evolution of Intel x86 architecture.		
UNIT-II	**ARITHMETIC AND LOGIC UNIT**	**9**
Look ahead carries adders. Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations. Floating point arithmetic operation, Arithmetic & logic unit design.		
UNIT-III	**CONTROL UNIT**	**9**
Instruction types, formats, instruction cycles and sub cycles (fetch and execute etc), micro operations, execution of a complete instruction. Program Control, Pipelining- Basic concepts – Data hazards – Instruction hazards- Data path and control considerations. Hardwired and micro programmed control: micro programme sequencing, concept of horizontal and vertical microprogramming.		
UNIT-IV	**MEMORY SYSTEM**	**9**
Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache memories – Improving cache performance –Associative memories – Secondary storage devices – Memory management requirements – Introduction to Virtual Memory. Case Study: RAID		
UNIT-V	**I/O ORGANIZATION**	**9**
Accessing I/O devices – Programmed Input/output –Interrupts – Direct Memory Access – Buses – Interface circuits – Standard I/O Interfaces (PCI, SCSI, and USB), I/O devices and processors		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Comprehend the basic structure and operation of digital computer system.
●	Understand the design of the various functional units and components of computers
●	Understand the Hazards and to design and analyse the pipelined control units.
●	Evaluate performance of memory systems.
●	Understand the IO devices organization.

Text Books:	
1	Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw Hill, 2002.
2	David A. Patterson and John L. Hennessey, “Computer organization and design’, Morgan Kauffman / Elsevier, Fifth edition, 2014.

Reference Books:	
1	William Stallings, “Computer Organization and Architecture – Designing for Performance”, Sixth Edition, Pearson Education
2	John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998.
3	V.P. Heuring, H.F. Jordan, “Computer Systems Design and Architecture”, Second Edition, Pearson Education, 2004.
4	Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications”, first edition, Tata McGraw Hill, New Delhi, 2005.

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19301.1	2	2	1	1	-	-	1	-	-	-	-	-	2	2	2
AI19301.2	3	3	1	2	-	-	-	-	2	-	1	-	1	1	2
AI19301.3	2	2	3	1	2	1	2	-	-	-	2	-	2	2	1
AI19301.4	2	2	2	1	2	2	2	-	-	-	2	1	2	2	2
AI19301.5	2	2	3	1	2	2	2	-	-	-	2	-	2	3	2
Average	2.2	2.2	2	1.2	2	1.6	1.75	-	2	-	1.75	1	1.8	2	1.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CS19341	DESIGN AND ANALYSIS OF ALGORITHMS	PC	3	0	2	4

Objectives: The student should be made to	
●	Learn and understand the algorithm analysis techniques and complexity notations
●	Become familiar with the different algorithm design techniques for effective problem solving in computing.
●	Learn to apply the design techniques in solving various kinds of problems in an efficient way.
●	Understand the limitations of Algorithm power.
●	Solve variety of problems using different design techniques

UNIT-I	**INTRODUCTION AND ANALYSIS OF ALGORITHMS**	**9**
Introduction –Algorithm Specification –Important Problem types- Performance Analysis: Space Complexity – Time Complexity – Asymptotic Notations – Using Limits for Comparing Orders of Growth – Basic Efficiency Classes- Solving Recurrence Relations: Substitution methods and Master Theorem Method		
UNIT-II	**BRUTE FORCE AND DIVIDE-AND-CONQUER**	**9**
Brute Force: Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem – Divide and Conquer Method: Analysis of Binary Search, Merge sort and Quick sort Algorithms, Integer Multiplication- Finding Minimum and Maximum.		
UNIT-III	**GREEDY TECHNIQUE AND DYNAMIC PROGRAMMING**	**9**
Greedy Method – Minimum Spanning Trees: Kruskals Algorithm– Fractional Knapsack – Huffman Codes – Dynamic Programming: General Method – String Editing – 0/1 Knapsack – Travelling Salesman Problem.		
UNIT-IV	**BACKTRACKING AND BRANCH & BOUND**	**9**
Backtracking: General Method – 8 Queen's Problem – Sum of Subsets Problem – Graph Colouring – Hamiltonian Circuit Problem – Branch and Bound: LC branch and bound – 0/1 Knapsack – Travelling Salesman Problem.		
UNIT-V	**STRING MATCHING AND NP COMPLETE & NP HARD**	**9**
String Matching: Naive String Matching – Rabin Karp – Knuth Morris Pratt – NP Complete and NP Hard Problems: Basic Concepts – Non Deterministic Algorithms – Class of NP Complete and NP Hard – Approximation Algorithms :: Travelling Salesman problem.		
	Contact Hours : 45	

List of Experiments			
1	Finding Time Complexity of algorithms.		
2	Design and implement algorithms using Brute Force Technique.		
3	Design and implement algorithms using Divide and Conquer Technique.		
4	Design and implement algorithms using **G**reedy Technique.		
5	Design and implement algorithms using Dynamic Programming.		
6	Design and implement algorithms using Backtracking.		
7	Design and implement algorithms using Branch and Bound.		
8	Implement String Matching algorithms.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Analyze the time and space complexity of various algorithms and compare algorithms with respect to Complexities.
●	Decide and apply Brute Force and Divide and Conquer design strategies to Synthesize algorithms for appropriate computing problems.
●	Apply Greedy and Dynamic Programming techniques to Synthesize algorithms for appropriate computing problems.
●	Apply Backtracking and Branch and Bound techniques to Synthesize algorithms for appropriate computing problems.
●	Apply string matching algorithms in vital applications.

Text Books:	
1	AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education,

	2012.
2	Ellis Horowitz, Shani, SanguthevarRajasekaran, “Computer Algorithms” Universities Press, Second Edition 2008.

Reference Books:	
1	Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3	Donald E. Knuth, “The Art of Computer Programming”, Volumes 1& 3 Pearson Education, 2009.
4	Sara Baase Allen Van Gelder, “Computer Algorithms – Introduction to Analysis” Pearson Education Asia, 2010
5	Droomey R. G, “How to solve it by Computer”, Pearson Education, 2006.

Web links for virtual lab:	
1	https://www.geeksforgeeks.org/fundamentals-of-algorithms/
2	https://www.hackerrank.com/domains/algorithms

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS19341.1	3	-	-	-	-	-	-	-	-	-	-	1	3	2	2
CS19341.2	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CS19341.3	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CS19341.4	2	3	2	2	-	-	-	-	-	-	-	1	3	3	1
CS19341.5	1	2	2	2	-	-	-	-	-	-	-	1	3	3	1
Average	2	2.8	2	2	-	-	-	-	-	-	-	1	3	2.8	1.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19341	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	PC	3	0	2	4

Objectives:	
●	Understand the various characteristics of a problem solving agent
●	Learn about the different strategies involved in problem solving
●	Learn about solving problems with various constraints.
●	Apply A.I to various applications like expert systems etc.
●	Understand the different models of learning

UNIT-I	**Introduction to Artificial intelligence and Problem-Solving Agent**	9
Problems of AI, AI technique, Tic – Tac – Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.		
UNIT-II	**Search techniques**	9
Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search.		
UNIT-III	**Constraint satisfaction problems and Game Theory**	9
Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.		
UNIT-IV	**Knowledge & reasoning**	9
Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning.		
UNIT-V	**Introduction to Machine Learning**	9
Exploring sub-discipline of AI: Machine Learning, Supervised learning, Unsupervised learning, Reinforcement learning, Classification problems, Regression problems, Clustering problems, Introduction to neural networks and deep learning.		
	Contact Hours : 45	

List of Experiments				
1	Programs on Problem Solving			
	a.	Write a program to solve 8 Queens problem		
	b.	Solve any problem using depth first search		
	c.	Implement MINIMAX algorithm		
	d.	Implement A* algorithm		
2	Programs on Decision Making and Knowledge Representation			
	a.	Introduction to PROLOG		
	b.	Implementation of Unification and Resolution Algorithm		
	c.	Implementation of Backward Chaining		
	d.	Implementation of Forward Chaining		
3	Programs on Planning and Learning			
	a.	Implementation of Blocks World program		
	b.	Implementing a fuzzy inference system		
	c.	Implementing Artificial Neural Networks for an application using python		
	d.	Implementation of Decision Tree		
	e.	Implementation of K-mean algorithm		
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Lab Specifications:

- The lab can be implemented using Python or C.
- Knowledge representation experiments can be performed using a PROLOG TOOL.

Course Outcomes: On completion of the course, the students will be able to	
●	Basic knowledge representation, problem solving, and learning methods of artificial intelligence.
●	Provide the apt agent strategy to solve a given problem
●	Represent a problem using first order and predicate logic
●	Design applications like expert systems and chat-bot.
●	Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem

Text Books:	
1	S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2015.
2	Nils J. Nilsson, Artificial Intelligence: A New Synthesis (1 ed.), Morgan-Kaufmann, 1998. ISBN 978-1558605350.

Reference Books:	
1	Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed.,2017.
2	Introduction to Artificial Intelligence & Expert Systems, Patterson, Pearson, 1st ed. 2015
3	Logic & Prolog Programming, Saroj Kaushik, New Age International, Ist edition, 2002.
4	Expert Systems: Principles and Programming,11 March 1998. Edition: 4th. ISBN: 9788131501672

CO – PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19341.1	3	3	1	-	2	1	1	1	1	-	2.2	1	2	1	1
AI19341.2	2	2	1	-	2	1	2	-	-	-	2	2	1	1	1
AI19341.3	3	3	1	-	3	-	1	-	-	-	3	1	2	3	2
AI19341.4	2	3	-	-	2	1	1	1	-	-	2	2	2	2	3
AI19341.5	2	2	2	2	3	-	1	2	-	-	3	3	3	3	3
Average	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	-	2.0	1.8	2.0	2.0	2.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19342	OBJECT ORIENTED PROGRAMMING USING JAVA FOR AI	PC	3	0	4	5

Objectives:	
●	To understand Object Oriented Programming concepts and characteristics of Java
●	To know the principles of classes, abstraction and inheritance
●	To create packages, define exceptions and use strings
●	To use I/O streams in applications
●	To build simple programs using collection and regular expression

UNIT-I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	9
Introduction to Object Oriented Programming – Basic concepts of OOP - An overview of Java - Java Architecture – Data Types – Variables- Arrays- Operators – Control Statements – Command Line Arguments.		
UNIT-II	**CLASSES AND INHERITANCE**	**9**
Defining Classes in Java: Methods, Constructors, Garbage Collection – Access Specifiers – Method Overloading – Inheritance: Super keyword, this keyword, Method Overriding, Abstract Classes – Static Members – Final Method and Class.		
UNIT-III	**PACKAGES, EXCEPTION HANDLING AND STRINGS**	**9**
Packages – Interfaces – Exceptions – Exception Hierarchy – Throwing and Catching Exceptions – Built-in Exceptions, User defined Exceptions – Strings – String Buffer.		
UNIT-IV	**I/O**	**9**
Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.		
UNIT-V	**COLLECTIONS AND REGULAR EXPRESSION**	**9**
Generic Programming – Generic Classes – Generic Methods – Collection Interfaces – Collection Classes. Regular Expression-Classes-Pattern, matcher-Interfaces – Regex Character Classes – Regex Quantifier-Meta charcters.		
	Contact Hours : 45	

List of Experiments			
1	Simple programs using command line arguments.		
2	Programs using control structures.		
3	Programs using arrays.		
4	Programs using Programs using classes and objects.		
5	Programs using inheritance and interfaces.		
6	Programs using packages and abstract class.		
7	Programs to handle different types of exceptions.		
8	Programs using strings and string buffer.		
9	Programs using I/O streams.		
10	Programs using files.		
11	Programs using collections.		
12	Program to validate MAC address using regular expression.		
13	Program to validate Indian driving license number using regular expression.		
14	Program to check whether two convex regular polygons have same center or not.		
15	Program to check if an URL is valid or not using pattern matching.		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**105**

Course Outcomes:	
On completion of the course, the students will be able to	
●	Understand the use of the Object Oriented Programming concepts.
●	Know about the concepts of Abstract, Static and final classes.
●	Understand the concept of packages, exceptions and strings
●	Understand I/O streams in applications.
●	Apply the collection and regular expression in real world applications.

Text Books:	
1	Herbert Schildt, ―Java The complete reference‖, 9th Edition, McGraw Hill Education, 2014.
2	Patrick Niemeyer, Daniel Leuck -Learning Java, 4th Edition, O'Reilly Media, June 2013
3	Cay S. Horstmann, Gary cornell, ―Core Java Volume –I Fundamentals‖, 9th Edition, Prentice Hall, 2013.

Reference Books:	
1	Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2	Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3	Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.
4	SCJP Sun Certified Programmer for Java 6 Study Guide. McGrawHill, 6th edition.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19342.1	2	2	1	-	1	-	-	-	-	-	-	1	2	2	2
AI19342.2	3	1	1	-	1	-	-	-	-	-	-	1	2	2	2
AI19342.3	3	2	2	-	1	-	-	-	-	-	-	1	2	2	2
AI19342.4	3	2	2	-	1	-	-	-	-	-	-	2	3	3	3
AI19342.5	3	2	2	3	1	-	-	-	1	1	3	2	3	3	3
Average	2.8	1.8	1.6	0.6	1	-	-	-	0.2	0.2	0.6	1.4	2.4	2.4	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MC19301	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	3	0	0	0

Objectives:	
●	This course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom are important in modern society with rapid technological advancements and societal disruptions. The course mainly focuses on introduction to Indian knowledge system, Indian perspective of modern science, basic principles of Yoga and holistic healthcare system, Indian philosophical, linguistic and artistic traditions.

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

UNIT-I	Introduction to Indian Knowledge System	6
Basic structure of the Indian Knowledge System –Veda – Upaveda - Ayurveda, Dhanurveda- Gandharvaveda, Sthapathyaveda and Arthasasthra. Vedanga (Six forms of Veda) – Shiksha, Kalpa, Nirukta, Vyakarana, Jyothisha and Chandas- Four Shasthras - Dharmashastra, Mimamsa, Purana and Tharkashastra		
UNIT-II	**Modern Science and Yoga**	**6**
Modern Science and the Indian Knowledge System – a comparison - Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga-different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies.		
UNIT-III	**Indian Philosophical Tradition**	**6**
Sarvadharshan/Sadhdharshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies.		
UNIT-IV	**Indian Linguistic Tradition**	**6**
Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology – Syntax and Semantics- Case Studies.		
UNIT-V	**Indian Artistic Tradition**	**6**
Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathya kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies.		
	Total Contact Hours : 30	

Course Outcomes: On completion of the course, the students will be able to	
●	Understand basic structure of the Indian Knowledge System
●	Apply the basic knowledge of modern science and Indian knowledge system in practice
●	Understand the importance Indian Philosophical tradition
●	Appreciate the Indian Linguistic Tradition.
●	Understand the concepts of traditional Indian art forms

Text Book(s):	
1	V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014.
2	Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.
3	Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan.
4	Fritzof Capra, Tao of Physics.
5	Fritzof Capra, The Wave of life.

Reference Books(s):	
1	VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam.
2	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
3	GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,Vidyanidhi Prakashan, Delhi 2016.
4	RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MC19301.1	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1
MC19301.2	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1
MC19301.3	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1
MC19301.4	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1
MC19301.5	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1
Average	-	-	-	-	-	1	1	3	2	-	-	1	-	-	1

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

No correlation : "-"

SEMESTER IV

Subject Code	Subject Name (Theory course)	Category	L	T	P	C
MA19456	OPTIMIZATION TECHNIQUES FOR AI	BS	3	1	0	4

Objectives:	
●	To learn the concepts of operations research applied in decision making.
●	To develop optimisation techniques applied to transportation models.
●	To understand multistage dynamic programming.
●	To obtain knowledge of solving problems using non linear programming.
●	To understand the concepts of project scheduling and critical path.

UNIT-I	INTRODUCTION TO LINEAR PROGRAMMING	12
Convex sets, Convex function, Linear Programming-formulation, solution by graphical and simplex methods, Primal - Penalty, Two Phase, Principles of Duality.		
UNIT-II	**LINEAR PROGRAMMING EXTENSIONS**	**12**
Transportation Models (Minimising and Maximising Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI algorithm. Case of Degeneracy. Assignment Models (Minimising and Maximising Problems) – Balanced and Unbalanced Problems. Solution by Hungarian. Travelling Salesman problem.		
UNIT-III	**INTEGER PROGRAMMING**	**12**
Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.		
UNIT-IV	**NON – LINEAR PROGRAMMING**	**12**
Unconstrained external problems, Newton – Ralphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.		
UNIT-V	**PROJECT SCHEDULING**	**12**
Network diagram representation – Critical path method – Time charts and resource leveling – PERT.		
	Total Contact Hours : 60	

Course Outcomes: On completion of the course, the students will be able to	
●	Solve optimization problems using simplex method.
●	Analyze problems involving materials and workforce using transportation and assignment models.
●	Apply integer programming and linear programming to solve real-life applications.
●	Apply unconstrained optimisation to problems with non linear objective functions.
●	Use PERT and CPM for problems in project management

Text Book(s):	
1	Hamdy A Taha, Introduction to Operations Research, Prentice Hall India, Seventh Edition, Third Indian Reprint 2004.
2	S. Boyd and L. Vandenberghe, Convex optimization, Cambridge University press,2004.

Reference Books(s):	
1	Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.
2	G. Srinivasan, Operations Research – Principles and Applications, PHI, 2007.
3	Gupta P.K, Hira D.S, Problem in Operations Research, S.Chand and Co, 2007.
4	Kalavathy S, Operations Research, Second Edition, Vikas Publishing House, 2004.
5	Frederick & Mark Hillier, Introduction to Management Science – A Modeling and case studies approach with spreadsheets, Tata Mcgraw Hill, 2005.
6	N. D Vohra, Quantitative Techniques in Management,TataMcgraw Hill, 2010.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA19456.1	3	3	2	3	1	-	-	-	-	-	-	2	3	2	1
MA19456.2	3	3	2	3	1	-	-	-	-	-	-	2	2	2	1
MA19456.3	3	3	2	3	1	-	-	-	-	-	-	2	3	2	2
MA19456.4	3	3	2	3	1	-	-	-	-	-	-	2	2	2	2
MA19456.5	3	3	2	3	1	-	-	-	-	-	-	2	2	2	3
Average	3	3	2	3	1	-	-	-	-	-	-	2	2.4	2	1.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation : "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19441	WEB DEVELOPMENT	PC	2	0	2	3

Objectives:	
●	To understand and practice Embedded Dynamic Client-side Scripting.
●	To understand Server-side Programming Language.
●	To implement manipulation of DOM events.
●	To learn basic architecture of Angular and React JS.

UNIT-I	WWW and JAVASCRIPT	6
WWW: Internet technologies Overview – Internet Standards & Protocols - HTTP. **JAVASCRIPT:** Introduction to Scripting - Data types and Variables - Operators, Expressions and Statements - Functions - Arrays - Objects - Document Object Model - Event Handling – JSON.		
UNIT-II	**SERVLETS**	**6**
Servlets: Java Servlet Architecture - Servlet Life Cycle - Form GET and POST actions- Session Handling - Understanding Cookies - Database Connectivity - JDBC.		
UNIT-III	**PHP**	**6**
PHP: Variables – Conditions, Branches, Loops - Arrays & Strings - Regular Expressions - Date and Time Functions - Integer and Float Functions - User-Defined Functions - Program control - Form Processing - Cookies - Database Connectivity.		
UNIT-IV	**JQUERY**	**6**
JQUERY: Introduction to jQuery – Selectors – Elements: Manipulations, Changing and Setting elements – Event Models: Event handlers – Animations & Effects – Functions – Plugins.		
UNIT-V	**ANGULAR 10 and REACTJS 16**	**6**
ANGULAR 10: TypeScript 3.8 – Node.js 14 - Angular Web Application - Components - Data Binding - Directives - Pipes - Service - Event Binding – Forms. **REACTJS 16:** React Features- ReactJS Vs React native-React JSX-components-state-props-lifecycle-events-forms-router-animation-table.		
	Contact Hours : 30	

List of Experiments	
1	Create a web page to embed a map along with hot spot, frames & links.
2	Create a web page using an embedded, external and inline CSS file.
3	Create an online job registration page along with java script validations.
4	Develop web page for Library Management System using Servlet and JavaScript program that will validate the controls in the forms you have created for the application and access a data from database.
5	Develop web page for Banking Management System using Servlet and JavaScript program that will validate the controls in the forms you have created for the application and access a data from database.
6	Create a program to implement the concepts of AJAX for web page login process.
7	Develop a Simple game using jQuery.
8	Write a PHP program for Employee Details, which includes EmpID, Name, Designation, Salary, DOJ, etc., to connect with the database and execute queries to retrieve and update data. Also, prepare the report for single and group of employees based on the end user needs.
9	Create an online application in any of the web application like PHP for Tourism management like the available trip details in season based. Type of mode, Concession details for passengers and Booking / Cancelling tickets.
10	Design a web page application using Angular 9
11	Design a registration page along with event handling using Angular 9
12	Design user interface using ReactJS
13	MINI-PROJECT (Suggested Domains):

	a) Inventory Control System b) Railway Reservation System c) Library Management System d) Banking System e) Exam Registration f) Stock maintenance system. g) Online course reservation system h) E-ticketing i) Software personnel management system j) Credit card processing k) e-book management system l) Recruitment system m) Foreign trading system n) Student Information System			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Design and implement dynamic web page with validation and event handling by applying Java Script.
●	Design and implement Server-side Programming using Servlet
●	Design and implement Server-side Programming using PHP
●	Design and implement client side webpage using jQuery.
●	Learn and design web application using Angular and React JS

Text Books:	
1	Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
2	Nate Murray, Felipe Coury, Ari Lerner, and Carlos, ng-book The Complete Guide to Angular, Fullstack.io, 2020.
3	Adam Freeman, Pro React 16, Apress, 2019.
4	Nln Lnc, Susan Fitzgerald,”React js: Hands-On full stack web development using React js”,2nd Edition, 2020.

Reference Books:	
1	Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
2	Bear Bibeault and Yehuda Katz, jQuery in Action, 2008.
3	Gopalan N.P. and Akilandeswari J., Web Technology, Prentice Hall of India, 2011.
4	UttamK.Roy, Web Technologies, Oxford University Press, 2011.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19441.1	2	2	1	-	1	-	-	-	-	-	-	1	2	2	2
AI19441.2	3	1	1	-	1	-	-	-	-	-	-	1	2	2	2
AI19441.3	3	2	2	-	1	-	-	-	-	-	-	1	2	2	2
AI19441.4	3	2	2	-	1	-	-	-	-	-	-	2	3	3	3
AI19441.5	3	2	2	-	1	-	-	-	-	-	-	2	3	3	3
Average	2.8	1.8	1.6	-	1	-	-	-	-	-	-	1.4	2.4	2.4	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
IT19441	OPERATING SYSTEM DESIGN	PC	3	0	4	5

Objectives:	
●	To study the basic concepts and functions of operating systems.
●	To learn about Processes, Threads, Scheduling algorithms and Deadlocks.
●	To study various Memory Management schemes.
●	To learn I/O Management and File Systems.
●	To learn the basics of Distributed operating systems.

UNIT-I	INTRODUCTION	9
Operating Systems Overview — OS Structure and Operations –Virtualization - System Calls – Types of System Calls- System Programs-System Boot Process – BIOS – POST- Bootstrap Loader.		
UNIT-II	**PROCESS MANAGEMENT**	**10**
Process Concepts– Process Scheduling - Operations - Interprocess Communication- Threads Overview - CPU Scheduling – FCFS – SJF – Priority – RR – Multilevel Queue Scheduling - Multilevel Feedback Queue - Process Synchronization – Critical Section Problem – Peterson's Solution – Synchronization Hardware –Semaphores- Classic Problems of Synchronization – Monitors – Deadlocks –Characterization-Prevention – Avoidance – Detection – Recovery.		
UNIT-III	**MEMORY MANAGEMENT**	**9**
Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of a page table – Segmentation - Virtual Memory – Demand Paging - Page Replacement-FIFO-LRU-Optimal - Allocation of Frames – Thrashing.		
UNIT-IV	**I/O MANAGEMENT**	**9**
File System -Concepts - Access Methods- Directory Structure - Mounting - Protection - File System Implementation – Directory Implementation – Allocation Methods – Free-Space Management - Mass Storage Structure - Disk Scheduling - Disk Management - Swap-Space Management.		
UNIT-V	**DISTRIBUTED OPERATING SYSTEMS**	**8**
Introduction to Distributed Systems: Distributed systems: Goals Hardware Concepts Software – design- Communication distributed systems: Layered Protocol: ATM Networks client server model - remote procedure call – group communication.		
	Contact Hours : 45	

List of Experiments			
1	Installation and Configuration of Linux in a Virtual Machine.		
2	Basic Linux commands.		
3	Shell Scripting.		
4	System calls based Programs.		
5	Inter-process Communication using Shared Memory.		
6	Scheduling algorithms.		
7	Producer Consumer Problem Solution using Semaphore.		
8	Deadlock Avoidance algorithm.		
9	Contiguous Memory Allocation.		
10	Page Replacement Algorithms.		
11	File Allocation Strategy.		
12	Study on Customization of Linux Kernel		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**105**

Course Outcomes: On completion of the course, the students will be able to	
●	Explain the concepts and structures of Operating Systems.
●	Design various Scheduling algorithms and methods to avoid Deadlock..
●	Compare and contrast various memory management schemes.
●	Summarize the concepts of I/O management and design a prototype file system.
●	Describe the concepts of Distributed operating systems.

Text Books:	
1	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, Ninth Edition, John Wiley and Sons Inc., 2012.

Reference Books:	
1	NikolayElenkov, "Android Security Internals : An In-Depth Guide to Android's Security Architecture, No Starch Press,2015.
2	William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Pearson, 2013.
3	Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.
4	Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 1996.
5	D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education, 2007.
6	Andrew S.Tanenbaum: Distributed Operating System, Prentice Hall International Inc. 1995.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
IT19441.1	2	-	-	-	3	-	1	-	1	2	2	2	3	-	1
IT19441.2	2	2	2	1	2	-	-	-	2	-	2	2	2	3	2
IT19441.3	2	2	2	1	2	-	-	-	1	-	2	2	2	3	2
IT19441.4	2	2	-	-	2	-	-	-	2	-	2	2	3	2	1
IT19441.5	2	-	1	-	2	-	-	1	1	-	2	2	3	-	2
Average	2	2	1.6	1	2.2	-	1	1	1.4	2	2	2	2.6	2.6	1.6

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19442	FUNDAMENTALS OF MACHINE LEARNING	PC	3	0	2	4

Objectives:	
●	To know the fundamentals of machine learning.
●	Be exposed to linear models.
●	Be familiar with basic machine learning algorithms with classification.
●	To understand machine learning algorithms with clustering.
●	To learn and apply reinforcement learning techniques.

UNIT-I	FOUNDATIONS OF LEARNING	8
Components of learning – learning models – geometric models – probabilistic models – logical models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve.		
UNIT-II	**LINEAR MODELS**	**9**
Linear classification – univariate linear regression - bivariate regression – multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's – Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models – Bayesian Logistic Regression.		
UNIT-III	**SUPERVISED LEARNING**	**10**
Perceptron: – multilayer neural networks – back propagation - learning neural networks structures – **support vector machines:** – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation. **Decision trees**: Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy - **Ensemble methods:** Bagging- Boosting- Boosting AdaBoost - Gradient Boosting – Xg boost.		
UNIT-IV	**UNSUPERVISED LEARNING**	**10**
Clustering: Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees. **Dimensionality Reduction:** – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.		
UNIT-V	**REINFORCEMENT LEARNING**	**8**
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control.		
	Contact Hours : 45	

List of Experiments				
1	A python program to implement univariate regression, bivariate regression and multivariate regression.			
2	A python program to implement Simple linear regression using Least Square Method			
3	A python program to implement logistic model.			
4	A python program to implement single layer perceptron.			
5	A python program to implement multi layer perceptron with back propagation.			
6	A python program to do face recognition using SVM classifier.			
7	A python program to implement decision tree.			
8	A python program to implement boosting.			
9	A python program to implement KNN and K-means.			
10	A python program to implement dimensionality reduction – PCA.			
11	Mini project – develop a simple application using tensorflow / keras.			
	Contact Hours	**:**	**30**	
	Total Contact Hours	**:**	**75**	

Course Outcomes: On completion of the course, the students will be able to	
●	Understand fundamentals of machine learning.
●	Apply the linear models for tuning parameters.
●	Understand and explore the machine learning algorithms with classification.
●	Apply machine learning algorithms with clustering and feature extraction.
●	Apply reinforcement learning techniques for various applications.

Text Books:	
1	Aurélien Géron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. September 21019, Reilly Media, Inc., ISBN: 9781492032649.
2	Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3	Shai Shalev-Shwartz and Shai Ben-David," Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press 2014.

Reference Books:	
1	Alex Smola and S.V.N. Vishwanathan," Introduction to Machine Learning", Cambridge University Press 2008.
2	Andreas C. Müller and Sarah Guido," Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, Inc,2016.
3	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.
4	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

Web links for virtual lab:	
1	https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So
2	https://nptel.ac.in/courses/106/106/106106139/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19442.1	3	3	2	-	-	-	-	-	1	-	-	-	3	1	-
AI19442.2	3	3	3	2	-	2	-	-	-	-	-	2	2	3	-
AI19442.3	3	3	3	2	3	-	-	2	2	-	-	-	-	3	-
AI19442.4	3	3	3	-	3	1	-	-	-	-	1	2	2	-	-
AI19442.5	3	3	2	3	2	-	-	1	3	-	3	3	3	3	1
Average	3	3	2.6	1.4	1.4	0.6	-	0.6	0.8	-	0.6	1.4	2	2	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CS19443	DATABASE MANAGEMENT SYSTEMS	PC	3	0	4	5

Objectives:	
●	To understand the role of a database management system, relational data model and successfully apply logical database design principles, including E-R diagrams.
●	To Construct simple and moderately advanced database queries using Structured Query Language (SQL).
●	To know the importance of functional dependency and normalization, and what role it plays in the database design process.
●	To familiarize with the concepts of a database transaction including concurrency control, backup and recovery, and data object locking and handling deadlocks.
●	To work with the foundation for NoSQL technologies

UNIT-I	INTRODUCTION TO DATABASE SYSTEMS	10
Introduction – Purpose of Database Systems - View of Data –Database Architecture - Relational Databases – Database Schema – Keys – Codd's Rule – Relational Algebra – Data Models – Entity Relationship Model – Constraints – Entity Relationship Diagram - Design Issues of ER Model – Extended ER Features – Mapping ER Model to Relational Model.		
UNIT-II	**SQL AND QUERY PROCESSING**	**10**
SQL: Data Definition – Domain types – Structure of SQL Queries - Modifications of the database – Set Operations – Aggregate Functions – Null Values – Nested Sub queries – Complex Queries – Views – Joined relations – Complex Queries – PL/SQL: Functions, Procedures, Triggers, Cursors -Embedded SQL – Query Processing – Heuristics for Query Optimization.		
UNIT-III	**DEPENDENCIES AND NORMAL FORMS**	**8**
Motivation for Normal Forms – Functional dependencies – Armstrong's Axioms for Functional Dependencies – Closure for a set of Functional Dependencies – Definitions of 1NF-2NF-3NF and BCNF – Multivalued Dependency 4NF - Joint Dependency- 5NF.		
UNIT-IV	**TRANSACTIONS**	**7**
Transaction Concept – State – ACID Properties – Concurrency control - Serializability – Recoverability – Locking based protocols –Timestamp Based Protocol - Deadlock handling.		
UNIT-V	**NOSQL DATABASE**	**10**
Introduction to NoSQL - CAP Theorem – Data Models - Key-Value Databases - Document Databases- Column Family Stores – Graph Databases –Working of NOSQL Using MONGODB/CASSANDRA.		
	Contact Hours : 45	

List of Experiments	
1	Introduction to SQL : DDL,DML,DCL,TCL.SQL clause :SELECT FROM WHERE GROUPBY,HAVING,ORDERBY Using SQLite/MySQL/Oracle
2	Creation of Views, Synonyms, Sequence, Indexes, Save point.
3	Creating an Employee database to set various constraints and subqueries.
4	Optimize a SQL query construct considering time complexity.
5	Write a PL/SQL block to specify constraints by accepting input from the user.
6	Implementation of PL/SQL Procedure (IN, OUT, INOUT) with Exception Handling.
7	Implementation of PL/SQL Function.
8	Implementation of PL/SQL Cursor.
9	Implementation of PL/SQL Trigger, Packages.
10	Implementation of NoSQL basic commands using Cassandra/Mongo DB.
11	Implementation of Data Model in NoSQL.
12	Implementation of Aggregation , Indexes in NoSQL.
13	**MINI PROJECT** Database Connectivity with Front End Tools(Python/C/C++/JAVA)and Back End Tools(MySQL/SQLite/CASSANDRA/MONGO DB) For any problem selected, write the ER Diagram, apply ER mapping rules, normalize the relations, and follow the application development process. Make sure that the application should have five or more tables, at least one trigger and one stored procedure, using suitable frontend tool. Indicative areas include a) Inventory Control System.

	b) Material Requirement Processing. c) Hospital Management System. d) Railway Reservation System. e) Personal Information System. f) Web Based User Identification System. g) Timetable Management System. Hotel Management System i)Library Management System.		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**105**

Course Outcomes: On completion of the course, the students will be able to	
●	Understand the use of the Relational model, ER diagrams.
●	Apply SQL Queries to define and manipulate the database.
●	Comprehend the concept of normalization and apply as a case study.
●	Know concurrency control and recovery mechanisms.
●	Relate the different models of NoSQL databases.

Text Books:	
1	Abraham Silberschatz, Henry F. Korth and S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata Mc Graw Hill, 2011.
2	P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

Reference Books:	
1	Ramez Elmasri and Shamkant B. Navathe,Fundamentals of Database Systems, 7th Edition, Pearson Education, 2016.
2	C.J.Date, A.Kannan and S.Swamynathan, “An Introduction to Database Systems”, 8th Edition, Pearson Education, 2006.
3	Atul Kahate, “Introduction to Database Management Systems”, Pearson Education, New Delhi, 2006.
4	Steven Feuerstein with Bill Pribyl,”Oracle PL/SQL Programming”, 6th edition, Publisher: O'Reill 2014.
5	Kristina Chodorow, Shannon Bradshaw, “MongoDB: The Definitive Guide”, 3rd Edition,O'Reilly Media,2019.

Web links for virtual lab:	
1	https://livesql.oracle.com/apex
2	https://www.jdoodle.com/online-mongodb-terminal/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CS19443.1	2	2	2	-	-	-	-	-	1	-	-	1	2	2	-
CS19443.2	2	2	3	3	3	-	-	-	2	1	2	1	2	1	-
CS19443.3	2	2	2	2	2	-	-	-	2	1	2	1	1	2	1
CS19443.4	2	2	2	2	2	-	-	-	1	1	-	-	1	2	1
CS19443.5	2	2	2	4	2	-	-	-	2	-	2	2	1	2	3
Average	2	2	2.2	2.8	2.3	-	-	-	1.6	1	2	1.3	1.4	1.8	1.7

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
GE19421	SOFT SKILLS I	EEC	0	0	2	1

Objectives:	
●	To help students break out of shyness.
●	To build confidence.
●	To enhance English communication skills.
●	To encourage students' creative thinking to help them frame their own opinions.

Learning and Teaching Strategy:
The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Week	Activity Name	Description	Objective
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.
5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate.

8	The art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question "Should students be required to wear uniforms at school?" might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
13	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Outcomes:	
●	Students should be able to be more confident.
●	Students should be able to speak in front of a large audience.
●	Students should be able to be better creative thinkers.
●	Students should be able to be spontaneous.
●	Students should be able to know the importance of communicating in English.

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	3	-	1	-	-	-
CO2	1	-	-	-	-	-	1	-	1	3	1	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1
Average	0.2	0	0	0	0.4	0	0.2	0	0.4	3	0.2	0.4	0	0	0.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19541	FUNDAMENTALS OF DEEP LEARNING	PC	3	0	2	4

Objectives:	
●	To introduce the different activation functions.
●	To familiarize various Training Techniques.
●	To learn about Convolutional Neural Network.
●	To introduce the different models of Deep Learning.
●	To familiarize generative deep learning.

UNIT-I	INTRODUCTION TO DEEP LEARNING	9
Perceptrons to Neural Networks - Activation Function - Calculating Multidimensional Arrays - Implementing a Three-Layer Neural Network - Designing the Output Layer - Identity Function and Softmax Function - Handwritten Digit Recognition. Neural Network Training: Learning from Data – Loss Function. CHAPTER – 3 & 4 (T1)		
UNIT-II	**TRAINING TECHNIQUES**	**9**
Numerical Differentiation – Gradient – Implementing a Training Algorithm - Stochastic Gradient Descent – Momentum – AdaGrad – Adam – Initial Weight Values – Regularization – Validating Hyper parameters. CHAPTER – 4 & 6 (T1)		
UNIT-III	**CONVOLUTIONAL NEURAL NETWORKS**	**9**
Overall Architecture – The convolution layer – The pooling layer – Implementing the Convolution and Pooling Layers – Implementing a CNN – Visualizing a CNN – Typical CNNs. CHAPTER – 7 (T1)		
UNIT-IV	**ACCELERATING DEEP LEARNING MODELS**	**9**
Making a Network Deeper – ImageNet – VGG – GoogLeNet – ResNet – Accelerating Deep Learning – Practical Uses of Deep Learning – The Future of Deep Learning. CHAPTER – 8 (T1)		
UNIT-V	**GENERATIVE DEEP LEARNING AND BEST PRACTICES**	**9**
Generative deep learning: Text generation – Deep dream – Neural style transfer – Generating images with variational autoencoders – Introduction to Generative Adversarial Networks. **Best practices for the real world:** Hyperparameter optimization - Model ensembling - Scaling up model training. CHAPTER – 12 & 13 (T2)		
	Contact Hours : 45	

List of Experiments				
1.	Implement handwritten digits classification.			
2.	Implement classification model using ImageNet database.			
3.	Study of different frameworks on deep learning (Tensor flow, Keras, PyTorch).			
4.	Implement basic convolutional neural network model for classification using Dogs vs. Cats dataset.			
5.	Implement VGG-16 model for classification using Dogs vs. Cats dataset.			
6.	Implement object recognition using YOLO.			
7.	Implement time series analysis for temperature forecasting using jena weather dataset.			
8.	Implement text processing model using TextVectorization layer for IMDB movie reviews dataset.			
9.	Generate MNIST image using generative adversarial networks.			
	Contact Hours	**:**	**30**	
	Total Contact Hours	**:**	**75**	

Course Outcomes:	
On completion of the course, the students will be able to	
●	Explain the basic concepts of activation function.
●	Apply various training techniques.
●	Implement convolutional neural network.
●	Develop different Deep Learning models.
●	Construct deep generative model for various applications.

Text Books:	
1	Koki Saitoh, “Deep Learning from the Basics - Python and Deep Learning: Theory and Implementation”, 2021 Packt Publishing.
2	François Chollet, “Deep Learning with Python” Second Edition, Manning (ISBN 9781617296864).

Reference Books:	
1	Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000.
2	Satish Kumar, "Neural Networks, A Classroom Approach", Tata McGraw -Hill, 2007.
3	Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

Web link:

1. **https://www.manning.com/books/deep-learning-with-python-second-edition**

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19541.1	3	3	2	2	1	-	-	1	-	-	-	1	3	3	1
AI19541.2	3	3	2	2	2	-	-	2	-	-	-	1	3	3	2
AI19541.3	3	3	3	2	2	-	-	2	-	-	-	1	3	3	1
AI19541.4	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
AI19541.5	3	3	3	2	3	1	1	2	1	1	-	1	3	3	3
Average	3	3	2.6	2	2.2	1	1	1.8	1	1	-	1	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19542	DATA SCIENCE USING R	PC	3	0	2	4

Objectives:	
●	To analyze data by applying basic data science techniques.
●	To understand basic constructs of R.
●	To learn and applying basic classification techniques.
●	To learn various black box techniques of classification, market basket analysis and clustering.
●	To evaluate performance of the models.

UNIT-I	R DATA STRUCTURES	9
Introduction – Managing and understanding data – Console input and output – Data Types – operators – Functions - R Data Structures – Vectors – Factors –Lists – Data Frames – Matrices and arrays – import and export files – Exploring and understanding data – Visualization – Categorical variables exploration – Relations between variables. (T1: Chapter – 1 & 2)		
UNIT-II	**CLASSIFICATION METHODS**	**9**
Classification – Lazy Learner - K-Nearest Neighbor – diagnosing breast cancer with kNN algorithm – Probabilistic Learner – Naïve Bayes – filtering mobile phone spam with naïve bayes algorithm – Divide and Conquer - Decision Trees and Rules – Understanding decision trees – identifying risky bank loan using C5.0 – Understanding classification rules –.identifying poisonous mushrooms with rule learners. (T1: Chapter – 3, 4 & 5)		
UNIT-III	**REGRESSION AND BLACK BOX METHODS**	**9**
Forecasting numerical data – Understanding regression – predicting medical expenses using linear regression - Understanding regression trees and model trees – estimating the quality of wines with regression trees and model trees – Neural Networks and SVM – Understanding neural networks – modeling the strength of concrete with ANNs – Understanding Support Vector Machines – performance OCR with SVMs. (T1: Chapter – 6 & 7)		
UNIT-IV	**PATTERNS AND CLUSTERING**	**9**
Finding Patterns – Market Basket Analysis using Association Rules – Understanding association rules – identifying frequently purchased groceries with association rules – Finding groups of data – Clustering with K-Means – Understanding clustering – Finding teen market segment using k-means clustering. (T1: Chapter – 8 & 9)		
UNIT-V	**EVALUATING MODEL PERFORMANCE**	**9**
Measuring performance for classifier – Beyond Accuracy – Kappa – Sensitivity and Specificity – Precision and recall – F-Measure – Visualization with ROC Curve – Estimate future performance – Improving Model Performance – Improving model performance with meta learners. (T1: Chapter – 10 & 11)		
	Contact Hours : 45	

List of Experiments			
1.	Basics of R – data types, vectors, factors, list and data frames.		
2.	Program to implement Breast Cancer with kNN.		
3.	Program to implement Filtering Mobile phone spam using Naïve Bayes		
4.	Program to implement Risky Bank Loans using Decision Trees		
5.	Program to implement Predict medical Expense with Linear Regression.		
6.	Program to implement Modeling strength of concrete.		
7.	Program to implement Identification of frequently Purchased groceries with Apriori algorithm.		
8.	Program to implement Finding Teen Segments of Market.		
9.	Program to implement Tuning stock models for better performance.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Understand the application and uses of data science techniques.
●	Apply basic constructs of R.
●	Apply data science by various classification techniques.
●	Apply market basket analysis and clustering techniques.
●	Evaluate the performance of the models built and fine tune the models to improve them.

Text Books:	
1	Brett Lantz , “Machine Learning with R”, ISBN 978-1-78216-214-8, 2019, Packt Publishing.
2	Beginning R: The Statistical Programming Language‖ , Mark Gardener, Wrox Wiley Publication, First Edition, 2012

Reference Books:	
1	Nina Zumel, John Mount, —Practical Data Science with R‖, Manning Publications, 2014
2	W. N. Venables, D. M. Smith and the R Core Team, —An Introduction to R‖, 2013
3	Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, —Practical Data Science Cookbook‖, Packt Publishing Ltd., 2014

Web link:

1. http://www.johndcook.com/R_language_for_programmers.html

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19542.1	2	2	2	1	1	-	-	-	-	-	1	2	2	3	2
AI19542.2	2	2	2	1	1	-	-	-	-	-	2	2	2	3	3
AI19542.3	2	2	2	2	2	-	-	-	-	-	2	3	3	3	3
AI19542.4	2	2	2	2	2	-	-	-	-	-	2	3	3	3	3
AI19542.5	2	2	2	2	2	-	-	-	-	-	2	3	3	3	3
Average	2	2	2	1.6	1.6	-	-	-	-	-	1.8	2.6	2.6	3	2.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CS19541	COMPUTER NETWORKS	PC	3	0	4	5

Objectives:	
●	Understand the concepts of computer networks and error detection-correction of data.
●	Be exposed to various addressing schemes and routing protocols.
●	Learn the Transport Layer, flow control and congestion control algorithms.
●	Be familiar with real time applications of networking devices and tools.
●	To configure different devices and trace the flow of information between nodes in the network using various tools.

UNIT-I	FUNDAMENTALS AND DATA LINK LAYER	9
Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Application Programming Interface (sockets) - Performance - Link layer Services - Framing – Error Detection and Correction - Reliable transmission.		
UNIT-II	**MEDIA ACCESS AND INTERNETWORKING**	**9**
Media Access Protocols – ALOHA - CSMA/CA/CD –Ethernet – Wireless LANs - 802.11- Bluetooth - Switching and Forwarding - Bridges and LAN Switches – Basic Internetworking- IP Service Model – IP fragmentation - Global Addresses – ARP - DHCP – ICMP- Virtual Networks and Tunnels.		
UNIT-III	**ROUTING**	**9**
Routing – Network as Graph - Distance Vector – Link State – Global Internet –Subnetting - Classless Routing (CIDR) - BGP- IPv6 – Multicast routing - DVMRP- PIM.		
UNIT-IV	**TRANSPORT LAYER**	**9**
Overview of Transport layer – UDP – TCP - Segment Format – Connection Management – Adaptive Retransmission - TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements.		
UNIT-V	**APPLICATION LAYER**	**9**
E-Mail (SMTP, MIME, POP3, IMAP), HTTP – DNS - FTP - Telnet – web services - SNMP - MIB – RMON.		
	Contact Hours : 45	

List of Experiments			
1.	To Configuration of Network in Linux Environment.		
2.	Learning and Assign of IP Address to computers.		
3.	Implementation of Subnet mask in IP addressing.		
4.	Write a socket PING program to testing the server connectivity.		
5.	Design, Build & Configure Networks using Cisco Packet Tracer tools.		
6.	Study & Implement the different types of Network Cables (RS 232C).		
7.	Implementation of setup a Local Area Network (using Switches) – Minimum 3 nodes and Internet.		
8.	Write a socket program Remote Procedure Call using connection oriented / connectionless protocols (programs like echo, chat, file transfer etc).		
9.	To Identify the various port & its usage using NMAP tool.		
10.	To capture, save, and analyze network traffic on TCP / UDP / IP / HTTP / ARP /DHCP /ICMP /DNS using Wireshark Tool.		
11.	Write a code using Raw sockets to implement packet Sniffing.		
12.	Perform a case study using OPNET / NS3 tools about the different routing algorithms to select the Network path with its optimum and economical during data transfer.		
13.	Simulation of Link State routing algorithm using OPNET or NS3 tool.		
14.	Simulation of Distance Vector Routing algorithm OPNET or NS3 tool.		
15.	To Analyze the different types of servers using Webalizer tool.		
	Contact Hours	**:**	**60**
	Total Contact Hours	**:**	**105**

Course Outcomes: On completion of the course, the students will be able to	
●	Choose the required functionality at each layer for given application.
●	Trace the flow of information from one node to another node in the network.
●	Apply the knowledge of addressing scheme and various routing protocols in data communication to select optimal path.
●	Monitor the traffic within the network and analyze the transfer of packets.
●	Develop real time applications of networks using different tools.

Text Books:	
1	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
2	Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition, McGrawHill, 2017.

Reference Books:	
1	William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON 1 and 2", Third Edition, Pearson Edition, 2009.
2	James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2017.
3	Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, 5th Edition, Prentice Hall publisher, 2010.
4	William Stallings, "Data and Computer Communications", Eighth Edition, Pearson Education, 2011.

Web link:

1. https://realpython.com/python-sockets/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS19541.1	3	2	1	0	3	1	1	1	1	0	1	1	2	1	1
CS19541.2	2	2	1	0	2	1	1	0	0	0	2	2	1	1	1
CS19541.3	3	3	1	0	3	0	1	0	0	0	2	1	2	3	2
CS19541.4	2	3	0	0	3	1	1	1	0	0	2	2	1	2	3
CS19541.5	3	2	2	2	3	0	1	1	0	0	3	3	3	3	3
Average	2.6	2.4	1	2	2.8	1	1	0.6	1	0	2	1.8	1.8	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
CB19342	COMPUTATIONAL STATISTICS	BS	3	0	2	4

Objectives:	
●	To study the mean, variance, linear regression models and error term for use in Multivariate data analysis.
●	To understand the relationship of the data collected for decision making.
●	To know the concept of principal components, factor analysis and cluster analysis for profiling and interpreting the data collected.

UNIT-I	**MULTIVARIATE NORMAL DISTRIBUTION**	**9**
Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.		
UNIT-II	**DISCRIMINANT ANALYSIS**	**9**
Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties.		
UNIT-III	**PRINCIPAL COMPONENT ANALYSIS**	**9**
Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.		
UNIT-IV	**FACTOR ANALYSIS**	**9**
Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.		
UNIT-V	**CLUSTER ANALYSIS**	**9**
Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters.		
	Contact Hours : 45	

List of Experiments				
1.	**Python Concepts, Data Structures, Classes:** Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files – Reading and Writing			
2.	**Visualization in Python:** Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches.			
3.	**Multivariate data analysis:** Multiple regression, multivariate regression, cluster analysis with various algorithms, factor analysis, PCA and linear discriminant analysis. Various datasets should be used for each topic.			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Analyze means and variances of the individual variables in a multivariate set and also the correlations between those variables.
●	To find discriminants, rules to optimally assign new objects to the labelled classes.
●	Apply the principal component techniques to reduce data and to interpret.
●	To reduce the number of variables in regression models using Factor analysis
●	Apply the techniques of clustering methods for massive amounts of data.

Text Books:	
1	T.W. Anderson.”An Introduction to Multivariate Statistical Analysis”. Wiley, Third edition, 2003
2	J.D. Jobson,”Applied Multivariate Data Analysis”, Volume I & II, Springer texts in statistics, New York, Fourth Edition 1999.
3	Python 3 for Absolute Beginners, Tim Hall and J-P Stacey. Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005.
4	Mark Lutz.,”ProgrammingPython”O'Reilly Media ,Germany, Fourth edition, 2011.

Reference Books / Web links:	
1	D.A. Belsey, E. Kuh and R.E. Welsch ,”Regression Diagnostics , Identifying Influential Data and Sources of Collinearety”
2	Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, ”Introduction to Linear Regression Analysis”, Fifth Edition, Wiley, 2012.
3	Johnson R.A. &Wichern, D.W, “Applied Multivariate Statistical Analysis “, Sixth Edition, Pearson, 2018.
4	Magnus Lie Hetland, “Beginning Python: From Novice to Professional”, Third Edition, Apress, 2005.
5	M.R. Anderberg, “Cluster Analysis for Applications”, Academic Press.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CB19342.1	3	2	3	3	2	1	-	-	-	2	2	-	2	2	2
CB19342.2	3	3	2	3	2	1	-	-	-	1	2	-	2	2	2
CB19342.3	3	3	2	3	3	1	-	-	-	1	2	-	2	3	2
CB19342.4	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
CB19342.5	3	3	2	3	3	2	-	-	-	2	2	-	2	3	3
Average	3.0	2.8	2.2	3.0	2.6	1.4	-	-	-	1.6	2.0	-	2.0	2.6	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

Subject Code	Subject Name (Laboratory Course)	Category	L	T	P	C
AI19511	MOBILE APPLICATION DEVELOPMENT LABORATORY FOR ML AND DL APPLICATIONS	PC	0	0	2	1

Objectives: Broad objective of this course is	
●	To know the components and structure of mobile application development frameworks for android and windows OS-based mobiles.
●	To understand how to work with various mobile application development frameworks.
●	To learn the basic and important design concepts and issues of development of mobile applications.
●	To be familiar with text and speech processing applications.
●	To be familiar with image processing applications.

List of Experiments				
1.	Introduction: About Android, Pre-requisites to learn Android, Dalvik Virtual Machine & .apk file extension, Android API levels (versions & version names). Android Java Basics: Getting started with Android development, project folder structure, simple programming, running project, generating build/APK of the app from Android Studio.			
2.	Develop an application to change the font and color of the text and display toast message when the user presses the button.			
3.	Develop a scientific calculator to perform arithmetic and mathematical functions using Math class. [Your scientific calculator should contain +, *, /, =, cos, sin, tan, pow, sqrt, log, Natural Log and mod].			
4.	Create a Database table with the following structure using SQLite: Student (Name, roll no, Marks) Develop an android application to perform the following operation using SQLite developer classes. a. Insert student Details b. Update the student Record c. Delete a specified record. View the details.			
5.	Design an android activity with two text boxes where the user can enter (username and ID) and a button (validate). Validate the entered username and ID field for the following using android code. a. Both the fields should not be empty, b. Name field should have alphabets, c. ID field should have numeric values (only 4-digit).			
6.	Develop an android application to perform the following: (Machine Learning based application) a. Text to Speech b. Speech to Text			
7.	Develop an application to read OCR on road signs (Deep Learning based application).			
8.	Develop an android application to capture image using camera and displaying the image using image view (Deep Learning based application).			
9.	Develop an android app for barcode scanning (Deep Learning based application).			
		Total Contact Hours	**:**	**30**

Course Outcomes: On completion of the course, the students will be able to	
•	Learn the components of mobile application development.
•	Gain the knowledge of how to work with various mobile application development frameworks.
•	Acquire the basic and important design concepts and issues of development of mobile applications.
•	Deploy simple text and speech processing.
•	Develop simple image processing mobile applications.

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
AI19511.1	3	3	3	3	3	3	2	2	-	-	1	3	3	3	2	3
AI19511.2	3	3	3	3	3	3	-	-	-	-	1	1	3	3	2	3
AI19511.3	3	3	3	3	3	-	-	2	2	-	2	2	3	2	3	3
AI19511.4	3	3	3	3	3	2	2	-	-	-	2	2	3	3	3	3
AI19511.5	3	3	3	3	3	2	2	-	-	-	2	2	3	3	3	3
Average	3	3	3	3	3	2	1.1	0.8	0.4	-	1.6	2	3	2.8	2.6	3

Correlation levels 1, 2 or 3 are as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial(High)

No correlation : "-"

Subject Code	Subject Name (Employability Enhancement Courses)	Category	L	T	P	C
GE19521	SOFT SKILLS II	EEC	0	0	2	1

Objectives:	
●	To help students break out of shyness.
●	To build confidence.
●	To enhance English communication skills.
●	To encourage students' creative thinking to help them frame their own opinions.

Learning and Teaching Strategy:

Week	Activity Name	Description	Objective
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own.	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out-of-the-box thinking to ensure a good debate and defense skills.
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.
4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move to the corner that they feel best explains their opinions.	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.
5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post few trials the students are given same opportunity to do the same with the crowd.	The aim of the lesson is designed to teach the art of questioning. It also helps to enhance the students' speaking and listening skills.
7	Debate	Does violence on the TV and Video games influence children negatively?	This activity aims at encouraging the students to debate on real life scenarios that most students spend a lot of time on.
8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	The aim of this activity is to make the participants become spontaneous and have good presence of mind.

9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	FictionAD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation.
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd.
13	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Course Outcomes:	
●	Be more confident
●	Speak in front of a large audience without hesitation
●	Think creatively
●	Speak impromptu
●	Communicate in English

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
GE19521.1	-	-	-	-	-	-	-	-	2	3	1	1	2	3	3
GE19521.2	-	-	-	-	-	-	-	-	2	3	2	-	-	1	2
GE19521.3	-	1	-	-	-	-	-	-	2	3	1	1	-	2	3
GE19521.4	-	-	-	-	-	-	-	-	2	3	-	-	1	1	1
GE19521.5	-	1	-	-	-	-	-	-	2	3	1	1	3	3	3
Average	0	1	0	0	0	0	0	0	2	3	1.25	1	2	2	2.4

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
BA19602	FUNDAMENTALS OF ACCOUNTING	HS	3	0	0	3

Objectives:	
●	To create an awareness about the importance and usefulness of the accounting concepts and their managerial implications.
●	To develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements.
●	To create awareness about cost accounting, different types of costing and cost management.
●	Understand how financial statement information can help solve business problems and increase the ability to read and understand financial statements and related information

UNIT-I	INTRODUCTION TO ACCOUNTING	9
Introduction to accounting : Meaning – Types of Accounting- Financial Accounting – Cost Accounting – Management Accounting – Users of accounting information -Accounting Cycle- Processing Accounting information.		
UNIT-II	**FINANCIAL ACCOUNTING**	**9**
Book Keeping and Record Maintenance, Fundamental Principles and Double Entry, Journal format - Ledger format- Trial Balance format (Elementary Problem) - Format of Final Accounts- Introduction to Capital Expenditure and Capital Revenue		
UNIT-III	**ANALYSIS OF FINANCIAL STATEMENTS**	**9**
Types of Financial Statements- Tools and techniques of Financial Statement analysis – Ratio analysis (Elementary Problems) – Trend Analysis and Trend Ratio (Problems)		
UNIT-IV	**MANAGEMENT ACCOUNTING**	**9**
Comparative and Common Size Financial Statements – Working Capital Estimation (Elementary Problem) – Introduction to Cash flow and Funds Flow statement – Difference between Cash flow and Funds Flow Statements		
UNIT-V	**COST ACCOUNTING**	**9**
Elements of Cost, Cost Behavior, Cost Sheet - Marginal Costing- Break Even Point Analysis (Elementary Problems) - Cost Volume Profit Analysis- Budgets- Types - Flexible Budget and Fixed Budget (Elementary Problems)		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Understand the theories, concept, and evolution of management.
●	Demonstrate the ability to employ the management way of thinking.
●	Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc.
●	Understand the qualities of a leader in the managerial aspect in future terms.
●	Understand the managerial ethics and CSR and its importance.

Text Books:	
1	Robert N Anthony, David Hawkins, Kenneth Marchant, “Accounting: Texts and Cases”, Thirteenth Edition, McGraw-Hill, 2017.
2	M.Y.Khan&P.K.Jain, “Management Accounting”, Tata McGraw Hill, 2011.
3	R.Narayanaswamy, Financial Accounting – A managerial perspective, Fifth Edition, PHI Learning, New Delhi, 2011.

Reference Books:	
1	Jan Williams, “Financial and Managerial Accounting – The basis for business Decisions”, Fifteenth Edition, Tata McGraw Hill Publishers, 2010.
2	Horngren, Surdem, Stratton, Burgstahler, Schatzberg, “Introduction to Management Accounting”, Sixteenth Edition, PHI Learning, 2014.

3	Stice&Stice," Financial Accounting Reporting and Analysis",Eight Edition, Cengage Learning, 2010.
4	SinghviBodhanwala, "Management Accounting -Text and cases", Third Edition, PHI Learning, 2018.
5	Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsevier, 2009.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
BA19602.1	2	1	2	1	2	3	2	2	-	-	2	2	-	-	-
BA19602.2	2	1	2	2	2	3	3	3	-	-	2	2	-	-	-
BA19602.3	2	1	2	3	2	3	2	2	-	-	2	2	-	-	-
BA19602.4	2	1	2	3	2	3	1	1	-	-	2	2	-	-	-
BA19602.5	2	1	2	3	2	3	2	2	-	-	2	2	-	-	-
Average	2	1	2	2.4	2	3	2.2	2	-	-	2	2	-	-	-

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19641	COMPUTER VISION AND ITS APPLICATIONS	PC	3	0	2	4

Objectives:	
●	Learn the basic concepts of image processing and computer vision.
●	Understand the ideas about image segmentation and feature based alignment.
●	Explore the ideas of Image Recognition and restoration.
●	Interpret various CNN model for object detection in Computer Vision.
●	Identify possible solutions to Train common problems with GAN model.

UNIT-I	INTRODUCTION	9
Introduction : Image formation -Geometric primitives and transformations - Photometric image formation - The digital camera- Image processing - Point operators - Linear filtering -More neighborhood operators -Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization - Feature detection and matching Points and patches - Edges – Lines (Chapter 1,2,3,4 of T1)		
UNIT-II	**IMAGE SEGMENTATION**	**8**
Segmentation : Active contours - Split and merge - Mean shift and mode finding - Normalized cuts -Graph cuts and energy-based methods - Feature-based alignment - **2D and 3D feature-based alignment** - Pose estimation -Geometric intrinsic calibration. (chapter 5,6 of T1)		
UNIT-III	**IMAGE RECOGNITION AND RESTORATION**	**10**
Object detection -Face recognition -Instance recognition - Category recognition -Context and scene understanding - Recognition databases and test set, **3D reconstruction** : Shape from X - Active range finding - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction -Recovering texture maps and albedos (chapter 12 and 14 of T1)		
UNIT-IV	**OBJECT DETECTION IN COMPUTER VISION**	**10**
CNN architectures-components of a CNN- Image classification using CNNs- Object detection with R-CNN, Object detection with Single-shot detector (SSD)- High-level SSD architecture- Base network- Multi-scale feature layer- Architecture of the multi-scale layers. case study: Train an SSD network in a self-driving car application(Link 5 Chapter 3,6,and 7)		
UNIT-V	**GENERATIVE ADVERSARIAL NETWORKS**	**8**
Overview of GAN Structure-Discriminator-Discriminator Training Data-Generator-GAN Training-Convergence-Loss Functions-Minimax Loss-Modified Minimax Loss-Wasserstein Loss. Case study: Build and train a GAN for generating hand-written digits in the TF-GAN (Link 5 chapter 8,Link 6)		
	Contact Hours :	**45**

List of Experiments			
1.	Write a program to demonstrate the working of CNN architecture to classify images		
2.	Build a simple CNN model for image segmentation		
3.	Build and train a CNN model for Face recognition(L3)		
4.	Design and train a model for objects detection with real time example		
5.	Design and implement Multiple Object Tracking using OpenCV(L9)		
6.	Load and implement the Face Detection method in OpenCV using python (L9)		
7.	Train an SSD network in a self-driving car application(L5)		
8.	A PyTorch implementation of Object Detection with Single Shot Detector (L8)		
9.	Building a simple Generative Adversarial Network (GAN) using TensorFlow		
10.	Build and train a GAN for generating hand-written digits(L5)		
	Contact Hours	:	**30**
	Total Contact Hours	:	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Design the computer vision application.
●	Explain the issue of segmentation in computer vision algorithms and implement in open CV.
●	Design and Build a CNN model for image recognition and object detection.
●	Train the CNN model with different real time application.
●	Build and train a GAN for generating hand written digits and other applications.

Text Books:	
1	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2	D. Forsyth and J. Ponce, "Computer Vision - A modern approach", 2nd edition, 2012 Pearson Education.

Reference Books:	
1	Richard Hartley and Andrew Zisser man, Multiple view geometry in computer vision 2nd edition, Cambridge University press, 2015 (printing).
2	Anil Jain K, "Fundamentals of Digital Image Processing", Prentice-Hall of India, 2001.

Web link:

1. http://vision.deis.unibo.it/fede/dida/computer_vision/
2. https://www.datacamp.com/community/tutorials/face-detection-python-opencv
3. https://vinsol.com/blog/2016/06/28/computer-vision-face-detection/
4. https://github.com/microsoft/computervision-recipes
5. https://livebook.manning.com/book/grokking-deep-learning-for-computer-vision/chapter-7/286
6. https://developers.google.com/machine-learning/gan/applications
7. https://www.pyimagesearch.com/2016/07/25/convolutions-with-opencv-and-python/
8. https://github.com/enginBozkurt/Object_Detection_With_SSD
9. https://opencv.org

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19641.1	-	2	-	3	3	-	-	-	-	-	-	-	2	3	2
AI19641.2	-	2	2	3	2	-	-	1	-	-	-	-	2	3	2
AI19641.3	2	3	-	3	2	-	-	1	-	-	-	-	2	3	2
AI19641.4	-	2		3	3	3	1	-	2	-	-	-	2	3	2
AI19641.5	-	2	-	3	2	-	-	2	2	-	-	-	2	3	2
Average	2	2.2	2	3	2.4	3	1	1.3	2	-	-	-	2	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19642	TIME SERIES ANALYSIS AND FORECASTING	PC	3	0	2	4

Objectives:	
●	To understand the basic concepts of time series analysis.
●	To familiarize the basic statistical methods to modeling, analyzing, and forecasting time series data.
●	To learn the application of regression models for forecasting.
●	To explore Autoregressive Integrated Moving Average (ARIMA) Models.
●	To introduce multivariate time series and forecasting models.

UNIT-I	INTRODUCTION OF TIMESERIES ANALYSIS	9
Time Series and Forecasting -Different types of data-Internal structures of time series-Models for time series analysis-Autocorrelation and Partial Autocorrelation-Examples of Time series- Nature and uses of forecasting-Forecasting Process-Data for forecasting –Resources for forecasting.(T2-CHAPTER NO:1, T1-CHAPTER NO 1)		
UNIT-II	**STATISTICS BACKGROUND FOR FORECASTING**	**9**
Graphical Displays-Time Series Plots - Plotting Smoothed Data - Numerical Description of Time Series Data - Use of Data Transformations and Adjustments- General Approach to Time Series Modelling and Forecasting- Evaluating and Monitoring Forecasting Model Performance. (T1- CHAPTER NO:2)		
UNIT-III	**REGRESSION ANALYSIS AND FORECASTING**	**9**
Introduction - Least Squares Estimation in Linear Regression Models - Statistical Inference in Linear Regression-Prediction of New Observations - Model Adequacy Checking -Variable Selection Methods in Regression - Generalized and Weighted Least Squares- Regression Models for General Time Series Data. (T1- CHAPTER NO:2)		
UNIT-IV	**AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS**	**9**
Linear models for stationary time series - Finite order moving average processes - Finite order autoregressive processes -Mixed autoregressive–moving average Processes – Non stationary processes - Time series model building forecasting ARIMA processes - Seasonal processes. (T1- CHAPTER NO:5)		
UNIT-V	**MULTIVARIATE TIME SERIES MODELS AND FORECASTING METHODS**	**9**
Multivariate Time Series Models and Forecasting - Multivariate Stationary Process- Vector ARIMA Models - Vector AR (VAR) Models - Neural Networks and Forecasting -Spectral Analysis – Bayesian Methods in Forecasting. (T1-CHAPTER NO:7)		
	Contact Hours : 45	

List of Experiments			
1.	Implement programs for time series data cleaning, loading and handling times series data and pre-processing techniques.		
2.	Implement programs for visualizing time series data.		
3.	Implement programs to check stationary of a time series data.		
4.	Implement programs for estimating & eliminating trend in time series data- aggregation, smoothing.		
5.	Develop a linear regression model for forecasting time series data.		
6.	Implement program to apply moving average smoothing for data preparation and time series forecasting.		
7.	Implement program for decomposing time series data into trend and seasonality.		
8.	Create an ARIMA model for time series forecasting.		
9.	Develop neural network-based time series forecasting model.		
10.	Develop vector auto regression model for multivariate time series data forecasting.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Explain the basic concepts in time series analysis and forecasting.
●	Apply various time series models for forecasting.
●	Analyze various time series regression models.
●	Distinguish the ARIMA modelling of stationary and non stationary time series.
●	Compare with multivariate times series and other methods of applications.

Text Books:	
1	Introduction To Time Series Analysis and Forecasting, 2nd Edition, Wiley Series in Probability and Statistics, By Douglas C. Montgomery, Cheryl L. Jen (2015).
2	Master Time Series Data Processing, Visualization, And Modeling Using Python Dr. Avishek PalDr. Pks Prakash (2017) .

Reference Books:	
1	Time Series Analysis and Forecasting by Example Soren Bisgaard Murat Kulahci Technical University of Denmark Copyright c2011 By John Wiley & Sons, Inc.
2	Peter J. Brockwell Richard A. Davis Introduction to Time Series and Forecasting Third Edition. (2016).
3	Multivariate Time Series Analysis and Applications William W.S. Wei Department of Statistical Science Temple University, Philadelphia, PA, SA 2019 John Wiley & Sons Ltd 2019.
4	Time Series Analysis and Forecasting by Example Soren Bisgaard Murat Kulahci Technical University Of Denmark Copyright c 2011 By John Wiley & Sons, Inc.

Web link:

1. https://b-ok.cc/book/3413340/2eb247

2.https://b-ok.cc/book/2542456/2fa941

3.https://b-ok.cc/book/1183901/9be7ed

4. https://www.coursera.org/learn/practical-time-series-analysis

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19642.1	2	1	1	1	2	-	-	-	-	-	-	2	3	3	2
AI19642.2	2	2	1	1	2	-	-	-	-	-	-	2	3	3	2
AI19642.3	2	2	3	1	3	-	-	-	1	-	1	2	3	3	2
AI19642.4	2	2	3	1	3	-	-	-	1	-	1	2	3	3	2
AI19642.5	2	2	3	1	3	-	-	-	1	-	1	2	3	3	2
Average	2	1.8	2.2	1	2.6	-	-	-	1	-	1	2	3	3	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19643	FOUNDATIONS OF NATURAL LANGUAGE PROCESSING	PC	3	0	2	4

Objectives:	
●	To understand the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
●	To learn mathematical foundations, Probability theory with Linguistic essentials such as syntactic analysis of text.
●	To learn mathematical foundations, Probability theory with Linguistic essentials such as and semantic analysis of text.
●	To familiarize the Statistical learning methods from deep learning.
●	To interpret cutting-edge research models from deep learning.

UNIT-I	INTRODUCTION TO NLP	9
Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory : Entropy, perplexity, The relation to language, Cross entropy(**T1:Chapters 1,2,3**)		
UNIT-II	**TEXT PREPROCESSING AND MORPHOLOGY**	**9**
Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer (**T1:Chapters 4)**		
UNIT-III	**LANGUAGE MODELLING**	**9**
Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios. Statistical Inference: n -gram Models over Sparse Data: Bins: Forming Equivalence Classes- N gram model - Statistical Estimators- Combining Estimators(**T1:Chapters 5, 6))**		
UNIT-IV	**WORD SENSE DISAMBIGUATION**	**9**
Methodological Preliminaries, Supervised Disambiguation: Bayesian classification, An information theoretic approach, Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.(**T1:Chapters 7)**		
UNIT-V	**MARKOV MODEL AND POS TAGGING**	**9**
Markov Model: Hidden Markov model, Fundamentals, Probability of properties, Parameter estimation, Variants, Multiple input observation. The Information Sources in Tagging: Markov model taggers, Viterbi algorithm, Applying HMMs to POS tagging, Applications of Tagging. (**T1:Chapters 9,10)**		
	Contact Hours : 45	

List of Experiments			
1.	Perform Morphological Analysis for an interrogative sentence, declarative sentence and complex sentences with more two sentences connected using conjunctions.		
2.	Perform Coarse-grained POS Tagging and Fine-grained POS Tagging.		
3.	Named Entity Recognition with Python.		
4.	Sentiment Analysis with Python.		
5.	Keyword Extraction with Python.		
6.	Spelling Correction Model with Python.		
7.	Resume Screening with Python.		
8.	Twitter Sentiment Analysis.		
9.	NLP For WhatsApp Chats.		
10.	NLP for Other languages.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**75**

Course Outcomes: On completion of the course, the students will be able to	
●	Realize semantics and pragmatics of English language for text processing
●	Create CORPUS linguistics based on digestive approach (Text Corpus method)
●	Check a current methods for statistical approaches to machine translation.
●	Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology.
●	Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

Text Books:	
1	Christopher D. Manning and HinrichSchutze, " Foundations of Natural Language Processing" , 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003 2009.
2	Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.

Reference Books:	
1	NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.
2	James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012
3	Chris Manning and HinrichSchütze, "Foundations of Statistical Natural Language Processing", 2nd edition, MITPress Cambridge, MA, 2003.
4	Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" MANNING Publications, 2019.
5	Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012
6	Rajesh Arumugam, RajalingappaShanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.

Web link:

1. https://blog.algorithmia.com/introduction-natural-language-processingnlp
2. https://www.udacity.com/course/natural-language-processingnanodegree--nd892
3. https://www.coursera.org/learn/language-processing
4. https://towardsdatascience.com/a-practitioners-guide-to-naturallanguage-processing-part- processing-understanding-text-9f4abfd13e72
5. https://www.edx.org/course/natural-language-processing

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19643.1	2	1	3	3	3	3	-	-	2	2	2	2	3	3	3
AI19643.2	2	1	3	3	3	3	-	-	2	2	2	2	3	3	3
AI19643.3	2	1	3	3	3	3	-	-	2	2	2	2	3	3	3
AI19643.4	2	3	3	3	3	3	-	-	2	2	2	2	3	3	3
AI19643.5	2	3	3	3	3	3	-	-	2	2	2	2	3	3	3
Average	2	1.8	3	3	3	3	-	-	2	2	2	2	3	3	3

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
AI19644	IOT ARCHITECTURE AND ITS PROTOCOLS	PC	3	0	2	4

Objectives:	
●	To learn basics of Embedded Systems Architecture.
●	To understand ISA Architecture Models and memory interfaces.
●	To interpret Smart Objects and IoT Architectures.
●	To familiarize about various IOT-related protocols.
●	To build simple IoT Systems using Arduino and Raspberry Pi.

UNIT-I	IOT FUNDAMENTALS	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs. **(Chapter 1 of T1)**		
UNIT-II	**IOT REFERENCE ARCHITECTURE, SOFTWARE DESIGN**	**9**
Control Units – Communication modules – Bluetooth – Zigbee – Wifi – GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc..), MQTT, Wired Communication, Power Sources. **(Chapter 7 of R1)**		
UNIT-III	**RESOURCE MANAGEMENT IN IOT**	**9**
Clustering - Clustering for Scalability - Clustering for routing - Clustering Protocols for IOT - The Future Web of Things – Set up cloud environment – Cloud access from sensors– Data Analytics for IOT. **(Chapter 3 of R2)**		
UNIT-IV	**IOT ACCESS TECHNOLOGIES**	**9**
IoT Access Technologies: Physical and MAC layers - topology and Security of IEEE 802.15.4 - 802.15.4g - 802.15.4e, Network Layer: Need for Optimization - Constrained Nodes - Constrained Networks – IP versions Optimizing IP for IoT: From 6LoWPAN to 6Lo - Routing over Low Power and Lossy Networks. **Case studies**: An IoT Blueprint for Public Safety. **(Chapter 1, 12 of T2 and Chapter 4, 5 and 15 of R3)**		
UNIT-V	**DESIGN AND DEVELOPMENT OF IOT APPLICATION**	**9**
Design Methodology - Embedded computing logic - Microcontroller - System on Chips – Basic building blocks of IoT - Arduino Board details - IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming **case studies** :illustrating to design home automation. **(Chapter 7and 9 of T2)**		
	Contact Hours :	**45**

List of Experiments			
1.	Familiarization with Arduino/Raspberry Pi and perform necessary software installation.		
2.	To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.		
3.	To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.		
4.	To interface Bluetooth/Wifi with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth/Wifi.		
5.	Mini Projects(any one for each group) i. Home Automation system with mobile Integration. ii. Weather Monitoring system using Raspberry Pi/Arduino iii. Automatic plant watering/irrigation system using Raspberry Pi/Arduino. iv. Vehicle Tracking System using Raspberry Pi/Arduino. v. Intrusion detection System using Raspberry Pi/Arduino. vi. Smart Parking System using Raspberry Pi/Arduino		
	Contact Hours	:	**30**
	Total Contact Hours	:	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Comprehend the architecture of Embedded systems.
●	Design and develop programs for specific embedded applications.
●	Apply the basic concepts of IoT.
●	Integrate various IoT Access Technologies.
●	Design and develop an IOT based real time application.

Text Books:	
1	ArshdeepBahga, Vijay Madisetti, "Internet of Things – A Hands-on Approach", Universities Press, India PVT Limited 2014.
2	David Hanes, Gonzalo Salgueiro, Rob Barton "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",Cisco Press June 2017.

Reference Books:	
1	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key Applications and Protocols", Wiley, 2012 .(CH-4)
2	Vermesan, Ovidiu, and Peter Friess, eds. Internet of things-from research and innovation to market deployment, 1st edition, Aalborg: River publishers, 2014.
3	David Hanes, Gonzalo Salgueiro, Rob Barton "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press June 2017.

Web link:

1.https://www.arduino.cc/

2.https://www.educba.com/applications-of-iot

3.https://www.edureka.co/blog/iot-applications

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19644.1	1	2	3	3	1	-	2	1	-	-	2	-	1	2	2
AI19644.2	1	1	3	3	3	2	-		2	1	2	2	2	2	1
AI19644.3	2	2	2	-	1		2					3	2	2	2
AI19644.4	2	1	1	2	3	2		1	2	1	2	2	2	2	3
AI19644.5	2	3	2	2	3	2	1		2	1	2	3	2	2	1
Average	1.8	1.8	2	2.3	2.5	2	1.5	1	2	1	2	2.5	2	2	1.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Courses)	Category	L	T	P	C
AI19611	MINI PROJECT	EEC	0	0	2	1

Objectives:	
●	To improve the design and development skills.

List of Domain Buckets (not limited)			
1.	Smart Automation		
2.	Smart Vehicles		
3.	Transportation & Logistics		
4.	Robotics and Drones		
5.	Clean & Green Technology		
6.	Travel & Tourism		
7.	Agriculture, Food Technology & Rural Development		
	Contact Hours	**:**	**30**

Course Outcomes: On completion of the course, the students will be able to	
●	Formulate the problem.
●	Design the architecture.
●	Develop solutions for real world problem.
●	Explain multi disciplinary ideas.
●	Prepare the report.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19611.1	3	3	3	3	3	1	2	1	3	3	3	3	3	3	3
AI19611.2	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3
AI19611.3	3	3	3	3	3	1	1	2	3	3	3	3	3	3	3
AI19611.4	3	3	3	3	3	1	2	1	3	3	3	3	3	3	3
AI19611.5	3	3	3	3	3	2	1	1	3	3	3	3	3	3	3
Average	3	3	3	3	3	1.2	1.4	1.2	3	3	3	3	3	3	3

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab Courses)	Category	L	T	P	C
GE19621	PROBLEM SOLVING TECHNIQUES	EEC	0	0	2	1

Objectives: Broad objective of this course is	
●	To improve the numerical ability and problem-solving skills.

List of Experiments				
1.	Numbers system			
2.	Reading comprehension			
3.	Data arrangements and Blood relations			
4.	Time and Work			
5.	Sentence correction			
6.	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning			
7.	Percentages, Simple interest and Compound interest			
8.	Sentence completion and Para-jumbles			
9.	Profit and Loss, Partnerships and Averages			
10.	Permutation, Combination and Probability			
11.	Data interpretation and Data sufficiency			
12.	Logarithms, Progressions, Geometry and Quadratic equations.			
13.	Time, Speed and Distance			
	Contact Hours	**:**	**30**	

Course Outcomes: On completion of the course, the students will be able to	
●	Have mental alertness
●	Have numerical ability
●	Solve quantitative aptitude problems with more confidence.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
GE19621.1	2	2	2	2	1	1	-	-	-	-	1	1	2	2	2
GE19621.2	3	3	2	3	1	1	-	-	-	-	1	1	2	2	2
GE19621.3	3	3	2	3	1	1	-	-	-	-	1	1	2	2	2
Average	2.7	2.7	2.0	2.7	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	2.0	2.0	2.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

SEMESTER – V

PROFESSIONAL ELECTIVE – I

Subject Code	Subject Name	Category	L	T	P	C
AI19P51	KNOWLEDGE REPRESENTATION AND REASONING	PE	2	0	2	3

Objectives:	
●	To learn the concepts of First Order Logics.
●	To understand the concepts of Knowledge Engineering and Resolution.
●	To acquire the knowledge of Rules, Fames and Structured Description.
●	To familiarize the fundamentals of uncertainty and degrees of belief.
●	To understand the fundamental concepts of Planning.

UNIT-I	**INTRODUCTION**	**6**
Introduction: The Key Concepts, Need for Knowledge Representation and Reasoning - The Role of Logic. **The Language of First-Order Logic:** Introduction-The Syntax- The Semantics-The Semantics-Explicit and Implicit Belief.(Text Book 1: Chapter 1 & 2)		
UNIT-II	**EXPRESSING KNOWLEDGE AND RESOLUTION**	**6**
Expressing Knowledge: Knowledge Engineering – Vocabulary - Basic Facts -Complex Facts - Terminological Facts Entailments- Other Sorts of Facts. **Resolution :** The Propositional Case- Handling Variables and Quantifiers - Dealing with Computational Intractability - Backward Chaining - Forward Chaining.(Text Book 1: Chapter 3, 4 & 5)		
UNIT-III	**RULES, FRAMES AND STRUCTURED DESCRIPTION**	**6**
Rules in Production System: Basic Operation, Working Memory, Production Rules and examples- Conflict Resolution- Applications and Advantages. **Frames:** objects and frames - Basic frame formalism- Frame examples. **Structured Description:** Descriptions- A Description Language- Meaning and Entailment- Computing Entailments- Taxonomies and Classification. (Text Book 1: Chapter 7,8 & 9)		
UNIT-IV	**UNCERTAINTY AND DEGREES OF BELIEF**	**6**
Non-categorical Reasoning- Objective Probability- Subjective Probability- Vagueness. **Explanation and Diagnosis:** Diagnosis- Explanation- A Circuit Example.(Text Book 1: Chapter 12 & 13)		
UNIT-V	**PLANNING**	**6**
Planning in the Situation Calculus - The STRIPS Representation- Planning as a Reasoning Task- Hierarchical Planning - Conditional Planning. (Text Book 1: Chapter 15)		
	Contact Hours : 30	

List of Experiments (can be implemented using Python**)**			
1.	Data preprocessing and annotation and creation of datasets.		
2.	Learn existing datasets and Treebanks.		
3.	Implementation of searching techniques in AI.		
4.	Implementation of Knowledge representation schemes.		
5.	Scientific distributions used in python for Data Science - Numpy, scify, pandas.		
6.	Scientific distributions used in python for Data Science- scikitlearn, statmodels, nltk.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Apply the concept of First Order Logic for knowledge representation.
●	Apply the concepts of unification and resolution to solve real time facts.
●	Integrate the concepts of rules and frames for real world phenomena.
●	Analyze the concept of uncertainty and degrees of belief to find the varying levels of knowledge and confidence level of real time facts.
●	Explain the concepts of planning to find the difference between plan space and state space.

Text Books:	
1	Ronald J. Brachman Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2	Deepak Khemani. A First Course in Artificial Intelligence , McGraw Hill Education (India), 2013.

Reference Books:	
1	Schank Roger C., Robert P. Abelson: Scripts, Plans, Goals, and Understanding: An Inquiry into Human Knowledge Structures. Hillsdale, NJ: Lawrence Erlbaum, 1977.
2	R. C. Schank and C. K. Riesbeck: Inside Computer Understanding: Five Programs Plus Miniatures , Lawrence Erlbaum, 1981.
3	Murray Shanahan: A Circumscriptive Calculus of Events. Artificial Intelligence 77(2) , pp. 249-284, 1995.
4	John F. Sowa: Conceptual Structures: Information Processing in Mind and Machine Addison–Wesley Publishing Company, Reading Massachusetts, 1984.
5	John F. Sowa: Knowledge Representation: Logical Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.

Web link:

1. https://www.cs.ox.ac.uk/people/james.worrell/lecture9-2015.pdf

2. https://www.section.io/engineering-education/forward-and-backward-chaining-in-ai/

3. https://www.cpp.edu/~ftang/courses/CS420/notes/planning.pdf

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19P51.1	2	1	1	1	1	-	-	-	-	-	1	1	2	1	1
AI19P51.2	3	2	1	1	1	-	-	-	-	-	1	1	2	1	1
AI19P51.3	2	1	1	1	1	-	-	-	-	-	1	1	2	1	1
AI19P51.4	3	2	1	1	1	-	-	-	-	-	1	1	2	1	1
AI19P51.5	3	2	1	1	1	-	-	-	-	-	1	1	2	1	1
Average	2.6	1.6	1	1	1	-	-	-	-	-	1	1	2	1	1

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
AI19P52	AI FOR GAME PROGRAMMING	PE	2	0	2	3

Objectives:	
●	To learn the fundamentals of Game programming.
●	To understand the 3D Graphics, vertex and pixel shader.scenes.
●	To learn the various PyGame Development process and its design attributes.
●	To interpret working knowledge in various game platforms.
●	To familiarize various games using reinforcement learning.

UNIT-I	**INTRODUCTION**	**6**
Elements of Game-Game Architecture-Application Layer-Game Logic-Game View for the Human Player-Game View for AI agents-Networked Game Architecture-Remote Game View-Remote Game Logic.(Text Book 1: Chapter 2)		
UNIT-II	**3D GRAPHICS**	**6**
3D Graphics Basics- Pipeline-3D MATH 101-Vector Classes-Matrix Mathematics-Quaternion Mathematics. 3D Vertex and Pixel Shader : Vertex Shader Syntax-Compiling the vertex shader-The pixel shader-Rendering the shader Helper Classes. 3D Scenes: Graph Basics-Special Scene Graph Nodes.(Text Book 1: Chapter 14,15,16)		
UNIT-III	**PYGAME AND 3D AND PYPLATFORMERS**	**6**
Installing Packages-Getting started with OpenGL-Adding the Pygame Library-Drawing the openGL-Basic Collision Detection Game-An introduction to Game Design-Introducing Pymunk-Building a Game Framework-Developing Pyplatformers.(Text Book 2 : Chapter 5 & 6)		
UNIT-IV	**AUGMENTING A BOARD GAME WITH COMPUTER VISION**	**6**
Planning the checker application-setting up OpenCV and Other dependencies-Supporting multiple version of Open CV-Configuring Cameras-Working With Colors-Building the analyser-Converting OpenCV images for wxPython-Building the GUI Application-Troubleshooting the projects.(Text Book 2 : Chapter 7)		
UNIT-V	**REINFORCEMENT LEARNING AND GAMES**	**6**
Intelligence and Games- Reinforcement Learning - Heuristic Planning - Adaptive Sampling-Deep Supervised Learning-Deep Reinforcement Learning.(Text Book 3:Chapter 2, 3,4, 5 and 6)		
	Contact Hours : 30	

List of Experiments (can be implemented using any tools: Play Canvas, jMonkey Engine, Direct 3D 11, Scratch , Python or Unity.**)**			
1.	Texture the Triangle using Direct 3D 11.		
2.	Programmable Diffuse Lightning using Direct3D 11.		
3.	To Implement Make Bouncing Ball Game.		
4.	To Implement " virtual pet" game.		
5.	To Implement " treasure hunt " game.		
6.	To Implement Shooting games.		
7.	To Implement Tynker games.		
8.	Introduction about PyGame, Unity software.		
9.	Learning 2D Game Development with Unity.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Explain the need for Game programming.
●	Integrate various concepts and techniques of 3D Game design.
●	Design and model interactive game.
●	Explain the need for advanced game development platforms.
●	Design and develop games using reinforcement learning.

Text Books:	
1	Mike “MrMike” McShaffry and David “Rez” Graham, “Game Coding Complete,Fourth Edition”, Course Technology PTR, A part of Cengage Learning.
2	Alejandro Rodas de Paz,Joseph Howse, “Python Game Programming By Example”, Packt Publishing,2015.
3	Learning to Play (Springer),Reinforcement Learning and Games by Aske Plaat,2020.

Reference Books:	
1	Jeremy Gibson, “Introduction to Game Design, Prototyping, and Development: From Concept to Playable Game with Unity and C#”, Addison-Wesley Professional, 2 nd edition, 2016.
2	John Horton, “Learning Java by Building Android Games”, Packt Publishing Limited, 1st edition, 2015.
3	Jorge Palacios, “Unity 5.x Game AI Programming Cookbook”, Packt Publishing Limited, 1st edition, 2016.

Web link:

1. https://docplayer.net/62131747-Python-game-programming-by-example.html

2. https://www.3dgep.com/introduction-opengl/

3. https://link.springer.com/chapter/10.1007/978-3-642-27645-3_17

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19P52 .1	1	2	2	2	2	-	-	-	-	-	-	-	1	1	-
AI19P52 .2	2	2	3	2	2	-	-	-	-	-	-	-	2	2	-
AI19P52.3	2	2	3	3	3	-	-	-	-	-	2	-	3	3	-
AI19P52.4	2	2	3	3	3	-	-	-	-	-	2	-	3	3	2
AI19P52.5	2	2	3	3	3	-	-	-	-	-	2	-	3	3	2
Average	1.8	2	2.8	2.6	2.6	-	-	-	-	-	1.2	-	2.4	2.4	0.8

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

Subject Code	Subject Name	Category	L	T	P	C
AI19P53	MOBILE TECHNOLOGY	PE	3	0	0	3

Objectives:	
●	To understand the basic concepts of mobile computing.
●	To learn the basics of mobile telecommunication system.
●	To study the basic evolution of Modern Mobile Wireless Communication Systems.
●	To be familiar with the network layer protocols and Ad-Hoc networks.
●	To gain knowledge about different mobile platforms and application development.

UNIT-I	INTRODUCTION	9
Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA (Chapter 1,2 and 3 of T1)		
UNIT-II	**MOBILE COMMUNICATION SYSTEMS**	**9**
GSM-System architecture-DECT - System architecture-TETRA-UMTS and IMT-2000-Broadcast systems-Digital audio broadcasting -Digital video broadcasting-Convergence of broadcasting and mobile communications (Chapter 4 and 6 of T1)		
UNIT-III	**4G NETWORKS**	**9**
Personal Area Networks: PAN - Public wide-area Wireless Networks -First Generation (1G) Wireless Networks - Second Generation-GSM architecture and protocol(2G) Wireless Cellular Networks - Third Generation (3G) Wireless Networks - Vision for 4G- Cellular Mobile Wireless Network- Description of cellular system- Channel Assignment Schemes in cellular networks- Cellular Communication Principle-Radio Resource Management (Chapter 2,3,6,8,and 11 of R2)		
UNIT-IV	**WIRELESS NETWORKS**	**9**
Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security. (Chapter 8 of T1)		
UNIT-V	**MOBILE PLATFORMS AND APPLICATIONS**	**9**
Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues(Chapter 9,10 and 11 of T2) and (Link 1,2,3 and 4)		
	Contact Hours : 45	

Course Outcomes:	
On completion of the course, the students will be able to	
●	Explain the basic concepts of mobile communication.
●	Apply the concepts of mobile telecommunication systems.
●	Apply different generation of mobile technology.
●	Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.
●	Develop a mobile application using android/blackberry/ios/Windows SDK.

Text Books:	
1	Jochen Schiller, ―Mobile Communications‖, PHI, Second Edition, 2003
2	Prasant Kumar Pattnaik, Rajib Mall, ―Fundamentals of Mobile Computing‖, PHI Learning Pvt.Ltd, New Delhi – 2012.

Reference Books:	
1	Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005
2	Wireless Communications and Networks, 3G and beyond, ITI Saha Misra, TMH, 2009, 2013 by the McGraw Hill Education (India) Private Limited
3	William.C.Y.Lee,―Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition,TataMcGraw Hill Edition ,2006.
4	Principle of wireless Networks by Kaveh Pahlavan and Prashant Krishnamurthy, Pearson 2002.

Web link:

1. Android Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. Windows Phone DevCenter : http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19P53.1	-	2	-	2	-	-	-	-	-	-	-	2	2	1	1
AI19P53.2	2	2	3	2	2	1	-	-	2	1	-	2	1	2	1
AI19P53.3	1	2	2	3	2	2	1	1	-	-	-	3	2	3	2
AI19P53.4	1	2	3	2	3	1	-	2	1	-	-	1	-	-	-
AI19P53.5	1	2	3	2	3	1	-	2	1	-	2	2	-	-	-
Average	1.2	2	2.8	2.2	2.5	1.2	1	1.8	1.3	1	2	2	1.5	2.5	1.5

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

SEMESTER – VI

PROFESSIONAL ELECTIVE – II

Subject Code	Subject Name	Category	L	T	P	C
AI19P61	GPU PROGRAMMING	PE	2	0	2	3

Objectives:	
●	To learn the basics of GPU architectures.
●	To write programs for massively parallel processors.
●	To understand the issues in mapping algorithms.
●	To interpret different GPU programming models.
●	To familiarize various algorithms for GPU programming.

UNIT-I	**GPU ARCHITECTURE**	**6**
Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.		
UNIT-II	**PROGRAMMING ISSUES**	**6**
Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.		
UNIT-III	**OPENCL BASICS**	**6**
OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.		
UNIT-IV	**ALGORITTHMS ON GPU**	**6**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.		
UNIT-V	**CUDA PROGRAMMING**	**6**
Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.		
	Contact Hours : 30	

List of Experiments			
1.	To write a c/c++ CUDA program to get introduced to heterogeneous computing.		
2.	To write a c/c++ CUDAprogram to do parallel computing using blocks.		
3.	To write a c/c++ CUDA program to get introduced to threads.		
4.	To write a c/c++ CUDA program to combine threads and blocks.		
5.	To write a c/c++ CUDA program to work on cooperating threads.		
6.	To write a c/c++ CUDA program to work on Asynchronous operation and Handling errors.		
7.	To write a c/c++ CUDA program to work on managing devices		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Explain the GPU architecture.
●	Implement programs using CUDA, identify issues and debug them.
●	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.
●	Develop simple programs using OpenCL.
●	Identify efficient parallel programming patterns to solve problems.

Text Books:	
1	Shane Cook, CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2	David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, ―Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.

Reference Books:	
1	Nicholas Wilt, ―CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison – Wesley, 2013.
2	Jason Sanders, Edward Kandrot, ―CUDA by Example: An Introduction to General Purpose GPU Programming, Addison – Wesley, 2010.
3	David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4	http://www.nvidia.com/object/cuda_home_new.html

Web link:

1. https://nptel.ac.in/courses/106/105/106105220/

2. https://www.udemy.com/course/cuda-gpu-programming-beginner-to-advanced/

3. https://www.coursera.org/courses?query=gpu

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19P61.1	3	3	1	-	2	1	1	1	1	-	2.2	1	2	1	1
AI19P61.2	2	2	1	-	2	1	2	-	-	-	2	2	1	1	1
AI19P61.3	3	3	1	-	3	-	1	-	-	-	3	1	2	3	2
AI19P61.4	2	3	-	-	2	1	1	1	-	-	2	2	2	2	3
AI19P61.5	2	2	2	2	3	-	1	2	-	-	3	3	3	3	3
Average	2.4	2.4	1.0	2.0	2.4	0.6	1.2	0.8	0.2	-	2.0	1.8	2.0	2.0	2.0

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name	Category	L	T	P	C
AI19P62	DATA ANALYSIS AND DATA MINING	PE	2	0	2	3

Objectives:	
●	To learn the introduction of Data Warehouse and Data Mining.
●	To understand the concepts of clustering analysis.
●	To learn the basics of mining text data.
●	To acquire the basics of mining spatial data.
●	To study the basic concepts of mining web data.

UNIT-I	INTRODUCTION TO DATA WAREHOUSE AND DATA MINING	6
Data Warehouse: Characteristics of Data Warehouse - Data Warehouse Components - Designing the Data Warehouse - Data Warehouse Architecture - Getting Heterogeneous Data into the Warehouse - Getting Multidimensional Data out of the Warehouse. **Data Mining:** Definition – Architecture – data mining: on what kind of data? - Data mining functionalities. (T2: Chapter – 1 and 2)		
UNIT-II	**CLUSTERING ANALYSIS**	**6**
Introduction – Feature selection for clustering – Representative based algorithms – Hierarchical clustering algorithms – probabilistic model based algorithms – Grid based and density based algorithms – Graph based algorithms – non negative matrix factorization – clustering validation. (T1: Chapter – 6)		
UNIT-III	**MINING TEXT DATA**	**6**
Document Preparation and Similarity computation – Specialized clustering methods for text – topic modeling – Specialized Classification Methods for Text – Novelty and First Story Detection. (T1: Chapter –13)		
UNIT-IV	**MINING SPATIAL DATA**	**6**
Mining with Contextual Spatial Attributes – Trajectory mining – Equivalence of Trajectories and Multivariate Time Series – Converting Trajectories to Multi dimensional Data – Trajectory Pattern Mining – Trajectory Clustering – Trajectory Outlier Detection – Trajectory Classification. (T1: Chapter –16)		
UNIT-V	**MINING WEB DATA**	**6**
Web crawling and Resource Discovery – Search Engine Indexing and Query Processing – Ranking Algorithm – Recommender Systems – Web Usage Mining. (T1: Chapter –18)		
	Contact Hours : 30	

List of Experiments				
	In H_2O implement the following			
1	Perform the basic pre-processing operations on data relation such as removing an attribute and filter attribute bank data			
2	To predict the Numerical Values in the given Data Set is using Regression Methods.			
3	To predict with the smallest total error using rules based on One attribute			
4	To understand the theoretical aspects and build a hierarchy of clusters using hierarchical clustering techniques			
5	To Demonstrate Clustering features in Large Databases with noise			
6	Generate association rule for the credit card promotion dataset using a priory algorithm with the support range 40% to 100% confidence as 10% incremental decrease as 5% and generate 6 rules			
		Contact Hours	**:**	**30**
		Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Explain the introduction of Data Warehouse and Data Mining.
●	Apply the concepts of clustering analysis.
●	Analyze the basics of mining text data.
●	Integrate the concepts of mining spatial data.
●	Demonstrate the basic concepts of mining web data.

Text Books:	
1	Charu C. Aggarwal, Data Mining: The Textbook, Springer 2015 Edition, Kindle Edition.
2	Sartaj Singh “Data Warehousing and Data Mining”, Lovely Professional University, Phagwara.

Reference Books:	
1	Usama M. Fayyad, Gregory Piatetsky - Shapiro, Padhrai Smyth, and Ramasamy Uthurusamy, "Advances In Knowledge Discovery And Data Mining", The M.I.T Press, 1996.
2	N. J. Nilsson, "Principles of Artificial Intelligence", Narosa Publishing House, 1980.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AI19P62.1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	1
AI19P62.2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	1
AI19P62.3	-	2	3	3	2	-	3	2	3	-	3	3	-	3	3
AI19P62.4	-	3	3	3	2	-	3	3	3	-	3	3	-	3	3
AI19P62.5	-	3	3	3	3	-	3	3	3	-	3	3	-	3	3
Average	1.2	2.8	2.2	1.8	1.4	-	1.8	1.6	1.8	-	1.8	1.8	1.2	1.8	2.2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: “-”

OPEN ELECTIVE COURSES OFFERED BY AIML

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
OAI1901	ARTIFICIAL INTELLIGENCE AND NEURAL NETWORK	OE	3	0	0	3

Objectives:	
●	Understand the various characteristic of a problem solving agent.
●	Learn about the different strategies involved in problem solving.
●	Learn about Knowledge Representation and reasoning.
●	To interpret the basic concepts of Neural Networks.
●	To learn various Neural Architecture Models.

UNIT-I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM SOLVING AGENT	9
Introduction : AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation CHAPTER – 1, 2 & 3 (R1)		
UNIT-II	**SEARCHING TECHNIQUES**	**9**
Heuristic search techniques: Generate and test - hill climbing - Breadth first search - A* algorithm - problem reduction - AO* algorithm - constraint satisfaction - means-ends analysis CHAPTER – 3 (T1)		
UNIT-III	**KNOWLEDGE REPRESENTATION AND REASONING**	**9**
Knowledge Representation - Using Predicate logic: representing simple facts in logic - representing instance and ISA relationships - computable functions and predicates - resolutions. Representing knowledge using rules: procedural Versus declarative knowledge - logic programming - forward versus backward reasoning. CHAPTER – 5 & 6 (T1)		
UNIT-IV	**INTRODUCTION TO NEURAL NETWORKS**	**9**
Introduction - Basic Architecture of Neural Networks: Single Computational Layer - Multilayer Neural Networks - Multilayer Network as a Computational Graph - Training a Neural Network with Backpropagation CHAPTER – 1 (T2)		
UNIT-V	**NEURAL ARCHITECTURE MODELS**	**9**
Common Neural Architectures - Advanced Topics: Reinforcement Learning - Separating Data Storage and Computations - Generative Adversarial Networks - Two Notable Benchmarks - The MNIST Database of Handwritten Digits - The ImageNet Database. Neural Architectures for Binary Classification Models: Revisiting the Perceptron - Least-Squares Regression - Logistic Regression - Support Vector Machines. CHAPTER – 1 & 2 (T2)		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Acquire the basic concepts of Artificial Intelligence and Problem solving agent.
●	Apply various searching techniques.
●	Understand the Knowledge Representation and Reasoning.
●	Explain the basic concepts of Neural Networks.
●	Apply various Neural Architecture Models.

Text Books:	
1	Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).
2	CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018.

Reference Books:	
1	Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/ Pearson Education
2	Neural networks and learning machines, simon haykin, 3rd edition, pearson, 2009.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
OAI1901.1	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
OAI1901.2	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
OAI1901.3	2	2	3	1	2	-	-	-	-	1	-	-	2	2	2
OAI1901.4	2	3	3	1	2	2	-	-	2	1	2	2	1	2	3
OAI1901.5	2	3	3	1	2	2	-	-	2	1	2	2	1	2	3
Average	2	2	2.2	1	2	2	-	-	2	1	2	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Lab oriented Theory Courses)	Category	L	T	P	C
OAI1902	INTRODUCTION TO MACHINE LEARNING	OE	2	0	2	3

Objectives:	
●	To know the fundamentals of machine learning.
●	Be exposed to regression models.
●	Be familiar with basic supervised learning algorithms
●	To understand machine learning algorithms with tree model.
●	To learn and apply unsupervised learning techniques.

UNIT-I	INTRODUCTION	6
Components of learning – learning models – geometric models – probabilistic models – logical models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve.		
UNIT-II	**REGRESSION MODELS**	**6**
Linear classification – univariate linear regression - bivariate regression – multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's – Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models – Bayesian Logistic Regression.		
UNIT-III	**SUPERVISED LEARNING**	**6**
Perceptron: – multilayer neural networks – back propagation - learning neural networks structures – **support vector machines:** – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation.		
UNIT-IV	**TREE MODELS**	**6**
Decision trees: Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy - **Ensemble methods:** Bagging- Boosting- Boosting AdaBoost - Gradient Boosting – Xg boost.		
UNIT-V	**UNSUPERVISED LEARNING**	**6**
Clustering: Nearest neighbor models – K-means – clustering around Medoids. **Dimensionality Reduction:** – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.		
	Contact Hours : 30	

List of Experiments			
1.	A python program to implement univariate regression, bivariate regression and multivariate regression.		
2.	A python program to implement logistic model.		
3.	A python program to implement single layer perceptron.		
4.	A python program to implement multi layer perceptron with back propagation.		
5.	A python program to do face recognition using SVM classifier.		
6.	A python program to implement decision tree.		
7.	A python program to implement KNN and K-means.		
	Contact Hours	**:**	**30**
	Total Contact Hours	**:**	**60**

Course Outcomes: On completion of the course, the students will be able to	
●	Understand basics of machine learning.
●	Analyze the regression models for refining parameters.
●	Understand and explore the supervised learning algorithms.
●	Apply tree models for feature extraction.
●	Examine the supervised learning algorithms.

Text Books:	
1	AurélienGéron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. September 21019, O'Reilly Media, Inc., ISBN: 9781492032649.

2	Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition,Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

Reference Books:	
1	Alex Smola and S.V.N. Vishwanathan," Introduction to Machine Learning", Cambridge University Press 2008.
2	Andreas C. Müller and Sarah Guido," Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, Inc,2016.
3	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall, 2009.
4	C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.

Web link:

1. https://www.coursera.org/lecture/python-machine-learning/introduction-4f2So

2. https://nptel.ac.in/courses/106/106/106106139/

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
OAI1902.1	2	1	1	1	2	-	-	-	-	-	-	-	1	2	1
OAI1902.2	2	1	1	1	2	-	-	-	-	-	-	-	1	2	1
OAI1902.3	2	1	3	1	3	-	-	-	-	1	-	-	1	2	2
OAI1902.4	2	1	3	2	3	2	-	-	2	1	2	2	1	2	3
OAI1902.5	2	1	3	2	3	2	-	-	2	1	2	2	1	2	3
Average	2	1	2.2	1.4	2.6	2	-	-	2	1	2	2	1	2	2

Correlation levels 1, 2 or 3 are as defined below:
1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
No correlation: "-"

Subject Code	Subject Name (Theory Courses)	Category	L	T	P	C
OAI1903	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	OE	3	0	0	3

Objectives:	
●	Prepare to become Junior RPA Developers.
●	Learn the basic concepts of Robotic Process Automation.
●	Develop familiarity and deep understanding of UiPath tools.
●	Develop the ability to design and create robots for business processes independently.
●	Develop skills required to pass UiPath RPA Associate v1.0 Exam.

UNIT-I	ROBOTIC PROCESS AUTOMATION (RPA) BASICS	9
History of Automation, Story of Work, Introduction to RPA, RPA vs Automation, RPA and AI, RPA and emerging ecosystem, Industries best-suited for RPA, Processes best-suited for automation.		
UNIT-II	**INTRODUCTION TO UIPATH, VARIABLES AND ARGUMENTS**	**10**
UiPath and its Products, Robots and their Types, Studio Overview, Orchestrator, UiPath Studio Installation & Updating, The User Interface, Features of Studio, Building 'Hello World' Automation Project. Variables and their Types, Variables Panel, Scope of a Variable, Arguments, Arguments Panel, Argument Directions, Arguments vs. Variables.		
UNIT-III	**SELECTORS AND CONTROL FLOW**	**10**
UI interactions, Input Actions and Input Methods, Containers, Recording and its types, Selectors and their types, Anchors, Fine-tuning Selectors. Sequences, Control Flow and its Types, Decision Control, Loops, Other Control Flow Activities, Flowcharts, Error Handling		
UNIT-IV	**DATA MANIPULATION, AUTOMATION CONCEPTS AND TECHNIQUES**	**9**
Data Manipulation and Its importance, String Manipulations, DataTable Manipulations, Collection, Its Types and Manipulations. Extraction and Its Techniques, Automation Techniques.		
UNIT-V	**UIPATH ORCHESTRATOR**	**7**
Orchestrator Overview, Publishing a Project to Orchestrator, Orchestrator Functionalities.		
	Contact Hours : 45	

Course Outcomes: On completion of the course, the students will be able to	
●	Become Junior RPA Developers.
●	Understand the basic concepts of Robotic Process Automation.
●	Understand the UiPath tools.
●	Design and create robots for business processes independently.
●	Develop projects using UiPath.

Text Books:	
1	Learning Robotic Process Automation: Create Software Robots and Automate Business Processes with the Leading RPA Tool – UiPath, Alok Mani Tripathi, Packt Publishing Ltd., 2018.
2	Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant Paperback, 2018.

Reference Books:	
1	Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere, Nandan Mullakara, Arun Kumar Asokan, Packt Publishing Ltd., 2020.
2	Tom Tauli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems" 1st Edition, Kindle Edition.

CO - PO – PSO matrices of course

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
OAI1903.1	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
OAI1903.2	2	1	1	1	2	-	-	-	-	-	-	-	3	2	1
OAI1903.3	2	2	3	1	3	-	-	-	-	1	-	-	2	2	2
OAI1903.4	2	3	3	2	3	2	-	-	2	1	2	2	1	2	3
OAI1903.5	2	3	3	2	3	2	-	-	2	1	2	2	1	2	3
Average	2	2	2.2	1.4	2.6	2	-	-	2	1	2	2	2	2	2

Correlation levels 1, 2 or 3 are as defined below:
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No correlation: "-"