RAJALAKSHMI ENGINEERING COLLEGE
(An Autonomous Institution Affiliated to Anna University, Chennai)

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	Neural Networks and 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.	AI19601	Embedded Systems and Internet of Things	PC	3	3	0	0	3
2.		Professional Elective-II	PE	3	3	0	0	3
3.	BA19602	Fundamentals of Accounting	HS	3	3	0	0	3
LAB ORIENTED THEORY COURSES								
4.	AI19641	Computer Vision and its Applications	PC	5	3	0	2	4
5.	AI19642	Time Series Analysis and Forecasting	PC	5	3	0	2	4
6.	AI19643	Foundations of Natural Language Processing	PC	5	3	0	2	4
EMPLOYABILITY ENHANCEMENT COURSES								
7.	AI19611	Mini Project	EEC	4	0	0	4	2
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	AI Techniques in 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	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 Analytics	PE	4	2	0	2	3
2.	AI19P82	Business Intelligence and Analytics	PE	4	2	0	2	3
3.	AI19P83	Quantum Computation and Information	PE	4	2	0	2	3
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.	AI19O01	Artificial Intelligence and Neural Network	OE	3	3	0	0	3
2.	AI19O02	Introduction to Machine Learning	OE	4	2	0	2	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	15	8		77
5	PE					3	3	9	3	18
6	OE					3			3	6
7	EEC				1	1	3	3	6	14
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, 2nd Edition, 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			
14	Create a web page to embed a map along with hot spot, frames & links.			
		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, 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.
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.