BHARATI VIDYAPEETH
(DEEMED TO BE UNIVERSITY), PUNE

Faculty of Science
B.TECH. Computer Science and Engineering (AI and ML)
New Syllabus

Bharati Vidyapeeth

(Deemed to be University)

Pune, India

College of Engineering, Pune

B.Tech. Computer Science and Engineering (Artificial Intelligence & Machine Learning)

Program Curriculum

(2021 Course)

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE

VISION OF UNIVERSITY:

Social Transformation Through Dynamic Education.

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination.
- To offer education to the students in a conducive ambience created by enriched infrastructure and academic facilities in its campuses.
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities.
- To make available quality education to the students of rural, tribal, and other deprived sections of the population.

VISION OF THE INSTITUTE:

To be World Class Institute for Social Transformation Through Dynamic Education.

MISSION OF THE INSTITUTE:

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

VISION OF THE DEPARTMENT:

To impart quality education and produce high quality, creative and ethical engineers and inculcate professionalism, enhance student's problem-solving skills in the domain of Artificial Intelligence and Machine Learning (AI and ML).

MISSION OF THE DEPARTMENT:

1. To provide skill-based education to master the students in problem solving and analytical skills to enhance their expertise in the field AI and ML.

2. To educate the students with latest technologies to update their knowledge in the field of AI and ML.

3. To guide students in research with aim of having an ethical impact on society by engaging in societal grand challenges.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates will be able to

1. Adapt, contribute and innovate ideas in the field of Artificial Intelligence and Machine Learning by productively engaging in research.
2. Pursue higher studies in Engineering or Management.
3. Demonstrate technical skills, competency and promote collaborative learning and team work spirit through multi - disciplinary projects and diverse professional activities.
4. Accomplish sustainable progress in the emerging computing technologies through life-long learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of the program, Graduates will be able to

PSO 1: Design and develop intelligent automated systems applying mathematical, analytical, programming and operational skills to solve real world problems.

PSO 2: Apply machine learning techniques, software tools to conduct experiments, interpret data and to solve complex problems.

PSO 3: Implement engineering solutions for the benefit of society by the use of AI and ML.

Program Outcomes (POs)

a) Apply the knowledge of Mathematics, Science, Engineering fundamentals and principles of Artificial Intelligence & Machine Learning to solve complex problems.
b) Identify, formulate, review, analyse complex problems, interpret data and solve through conducting experiments.
c) Design safe, socio-economical and environment friendly solutions or systems for complex engineering problems.
d) Design experimentation and interpretation of data using research-based knowledge and methods to provide valid solution
e) Create, select, and apply appropriate techniques and modern engineering tools.
f) Apply reasoning informed by the contextual knowledge to assess professional, ethical, legal, security and social issues as well as responsibilities.
g) Demonstrate the knowledge about the need for sustainable development in context to the environment and society.
h) Apply ethical principles in engineering practices and commit to professional ethics.
i) Function effectively on multidisciplinary teams to accomplish the goal.
j) To communicate effectively verbally and in writing on complex Engineering activities with a range of audiences.
k) Apply the knowledge and understanding of the Engineering and Management principles as a member and leader in a team to manage projects.
l) To recognize the need for lifelong learning and are expected to apply the techniques, skills, and modern engineering tools necessary for engineering practice and knowledge growth.

CORELATION BETWEEN GRADUATE ATTRIBUTES AND PROGRAMME OUTCOMES

Graduate Attributes/ Programme Outcomes	a	b	c	d	e	f	g	h	i	j	k	l
Engineering Knowledge	✓											
Problem Analysis		✓										
Design/Development of Solutions			✓									
Conduct Investigations of Complex Problems				✓								
Modern Tool Usage					✓							
The Engineer and Society						✓						
Environment and Sustainability							✓					
Ethics								✓				
Individual and Teamwork									✓			
Communication										✓		
Project Management and Finance											✓	
Life-long Learning												✓

DEFINITION OF CREDITS

Hour	Credit
1 Hour Lecture (L) per week	01 Credit
1 Hour Tutorial (T) per week	01 Credit
2 Hours Practical (P) per week	01 Credit
4 Hours Practical (P) per week	02 Credit

COURSE CODE AND DEFINITION

Course Code	Definitions
L	Lecture
P	Practical
T	Tutorial
ESE	End Semester Examination
TW	Term Work
OR	Oral
PR	Practical

BSC	Basic Science Course
ESC	Engineering Science Course
IA	Internal Assessment
CC	Core Course
LC	Laboratory Course
EC	Elective Course
VC	Vocational Course
INT	Internship
PROJ	Project
MOOC	Massive Open Online Course
SA	Social Activity

STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAMME

Sr. No.	Category	Breakup of Credits
1	Basic Science Course (BSC)	25
2	Engineering Science Course (ESC)	10
3	Core Course (CC)	132
4	Elective Course (EC)	10
5	Project (PROJ)	9
6	Internship (INT)	03
7	Vocational Course (VC)	04
8	Massive Open Online Course (MOOC)	04 (Add-On)
9	Research Paper Publication (Research)	02 (Add-On)
10	Social Activities (SA)	04 (Add-On)
11	Laboratory Course (LC)	7
12	Mandatory Audit Course (MC)	Non- Credit
TOTAL		**200**

DISTRIBUTION OF COURSE COMPONENTS

Sr. No.	Category	Number of Courses
1	Basic Science Course (BSC)	06
2	Engineering Science Course (ESC)	02
3	Core Course (CC)	28
4	Elective Course (EC)	02
5	Project (PROJ)	02
6	Internship (INT)	01
7	Vocational Course (VC)	04
8	Massive Open Online Course (MOOC)	02 (Add on)
9	Research Paper Publication (Research)	01 (Add on)
10	Social Activities (SA)	02 (Add on)
11	Laboratory Course (LC)	07
12	Mandatory Course (MC)	01
TOTAL		**57**

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – I CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Mathematics for Computing-I	3	-	1	60	40	-	-	-	100	3	-	1	**4**
2		Physics for Computing Systems	3	2	-	60	40	25	-	-	125	3	1	-	**4**
3		Electrical Technology	4	2	-	60	40	25	-	-	125	4	1	-	**5**
4		Internet Programming	4	2	-	60	40	25	25	-	150	4	1	-	**5**
5		Programming and Problem Solving	4	4	-	60	40	25	-	50	175	4	2	-	**6**
6		Computer Systems Workshop Technology	-	2	-	-	-	25	-	50	75	-	1	-	**1**
	Total		**18**	**12**	**1**	**300**	**200**	**125**	**25**	**100**	**750**	**18**	**6**	**1**	**25**

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – II CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Mathematics for Computing-II	3	-	1	60	40	-	-	-	100	3	-	1	**4**
2		Probability and Statistics	4	2	-	60	40	25	-	25	150	4	1	-	**5**
3		Organic and Electrochemistry	3	2	-	60	40	25	-	-	125	3	1	-	**4**
4		Digital Electronics	4	2	-	60	40	25	-	-	125	4	1	-	**5**
5		Object Oriented Programming	4	4	-	60	40	25	-	50	175	4	2	-	**6**
6		Server-Side Scripting Language	-	2	-	-	-	25	-	50	75	-	1	-	**1**
	Total		**18**	**12**	**1**	**300**	**200**	**125**	**-**	**125**	**750**	**18**	**6**	**1**	**25**

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – III CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Discrete Mathematical Structures	4	-	1	60	40	-	-	-	100	4	-	1	**5**
2		Python Programming*****	4	2	-	60	40	25	-	25	150	4	1	-	**5**
3		Data Structures	4	2	-	60	40	25	-	25	150	4	1	-	**5**
4		Computer Organization and Microprocessor	4	2	-	60	40	25	25	-	150	4	1	-	**5**
5		Database Management Systems	3	2	-	60	40	25	-	25	150	3	1	-	4
6		Vocational Course-I	-	2	-	-	-	25	25	-	50	-	1	-	1
	Total		**19**	**10**	**1**	**300**	**200**	**125**	**50**	**75**	**750**	**19**	**5**	**1**	**25**
	Social Activity - I		-	-	-	-	-	-	-	-	-	-	-	-	2

***Industry Taught Course -I**

List of Vocational Courses will be published by the department before the commencement of respective semester.

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – IV CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Theory of Computation	3	-	1	60	40	-	-	-	100	3	-	1	**4**
2		Operating System	4	2	-	60	40	25	-	25	150	4	1	-	**5**
3		Algorithms Analysis and Design	4	2	-	60	40	25	25	-	150	4	1	-	**5**
4		Data Warehousing and Mining*****	4	-	-	60	40	-	-	-	100	4	-	-	**4**
5		Foundations of Artificial Intelligence	4	2	-	60	40	25	-	25	150	4	1	-	**5**
6		Computing Lab-I	-	2	-	-	-	25	-	25	50	-	1	-	**1**
7		Vocational Course-II	-	2	-	-	-	25	25	-	50	-	1	-	**1**
	Total		**19**	**10**	**1**	**300**	**200**	**125**	**50**	**75**	**750**	**19**	**5**	**1**	**25**
	MOOC I[#]		-	-	-	-	-	-	-	-	-	-	-	-	2

***Industry Taught Course -II**

[#]Add on Course - List of MOOC & Vocational Courses will be published by the department before the commencement of respective semester.

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – V CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Machine Learning	4	2	-	60	40	25	-	25	150	4	1	-	**5**
2		Software Engineering*****	4	2	-	60	40	25	-	25	150	4	1	-	**5**
3		Internet of Things	4	2	-	60	40	25	25	-	150	4	1	-	**5**
4		Big Data Analytics	4	-	-	60	40	-	-	-	100	4	-	-	**4**
5		Compiler Construction	4	-	-	60	40	-	-	-	100	4	-	-	**4**
6		Computing Lab -II	-	2	-	-	-	25	-	25	50	-	1	-	**1**
8		Vocational Course-III**	-	2	-	-	-	25	25	-	50	-	1	-	**1**
	Total		**19**	**10**	**-**	**300**	**200**	**125**	**50**	**75**	**750**	**19**	**5**	**-**	**25**
	Social Activity - II		-	-	-	-	-	-	-	-	-	-	-	-	2
	Environmental Studies#		2	-	-	50	-	-	-	-	-	-	-	-	-

***Industry Taught Course –III**

**** List of Vocational Courses will be published by the department before the commencement of respective semester**

 # Mandatory Audit Course -

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – VI CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Deep Learning	4	2	-	60	40	25	-	25	150	4	1	-	**5**
2		Computer Network	4	2	-	60	40	**25**	25	-	150	4	1	-	**5**
3		Robotic Process Automation*****	4	2	-	60	40	25	-	25	150	4	1	-	**5**
4		Quantitative Techniques, Communication and Values	4	-	-	60	40	-	-	-	100	4	-	-	**4**
5		Soft Computing	4	-	-	60	40	-	-	-	100	4	-	-	**4**
6		Computing Lab - III	-	2	-	-	-	25	-	25	50	-	1	-	**1**
7		Vocational Course-IV	-	2	-	-	-	25	25	-	50	-	1	-	**1**
	Total		**20**	**10**	**-**	**300**	**200**	**125**	**50**	**75**	**750**	**20**	**5**	**-**	**25**
	MOOC II[#]		-	-	-	-	-	-	-	-	-	-	-	-	2

[*] **Industry Taught Course –IV**

[#] **Add- On Courses - List of MOOC & Vocational Courses will be published by the department before the commencement of respective semester.**

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – VII CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	E	IA	TW	OR	PR	Total	L	P	T	Total
1		High Performance Parallel Computing	3	2	-	60	40	25	-	25	150	3	1	-	**4**
2		Natural Language Processing*****	4	2	-	60	40	25	-	25	150	4	1	-	**5**
3		Computer Vision	3	2	-	60	40	25	-	25	150	3	1	-	**4**
4		Elective –I	4	-	1	60	40	-	-	-	100	4	-	1	**5**
5		Computing Lab -IV	-	2	-	-	-	25		25	50	-	1	-	**1**
6		Project Stage -I	-	2	-	-	-	50	50	-	100	-	3	-	**3**
7		Internship	-	-	-	-	-	25	25	-	50	-	3	-	**3**
	Total		**14**	**10**	**1**	**240**	**160**	**175**	**75**	**100**	**750**	**14**	**10**	**1**	**25**

***Industry Taught Course -V**

	1	2	3	4
Elective-I	AI in Block Chain	AI for Cyber Security	Business Intelligence and Analytics	Bioinformatics

Program: B.TECH. Computer Science and Engineering (AI and ML) Semester – VIII CBCS 2021 Course

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1		Data Visualization	4	2	-	60	40	25	-	25	150	4	1	-	**5**
2		Optimization Methods in Machine Learning	3	2	-	60	40	25	-	25	150	3	1	-	**4**
3		Reinforcement Learning*	4	-	-	60	40	-		-	100	4	-	-	**4**
4		Elective -II	4	-	1	60	40	-		-	100	4	-	1	**5**
5		Computing Lab -V	-	2	-	-	-	25	-	25	50	-	1	-	**1**
6		Project Stage -II	-	4	-	-	-	100	100	-	200	-	6	-	**6**
	Total		**15**	**10**	**1**	**240**	**160**	**175**	**100**	**75**	**750**	**15**	**09**	**1**	**25**
	Research Paper Publication		-	-	-	-	-	-	-	-	-	-	-	-	2

***Industry Taught Course -VI**

	1	2	3	4
Elective-II	Human Machine Interaction	Speech Recognition	Augmented Reality and Virtual Reality	Social Network Analytics

B.Tech. CSE (AI & ML)

Semester I Syllabus

Mathematics for Computing-I

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Lecture:	03 Hours/Week	**End Semester Examination:** 60 Marks	**Theory:**	03
Tutorial:	01 Hours/Week	**Internal Assessment:** 40 Marks	**Tutorial:**	01
Total:	04 Hours/Week	**Total:** 100 Marks	**Total:**	04

Course Objectives:

1. Linear equations and its basis and dimension.
2. Linear mapping and its matrix representation.
3. Orthogonalization and diagonalization of matrices.

Prerequisite: The students should have knowledge of algebra of matrices and determinants.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand to evaluate rank of matrix and its application in solving system of equations.
2. Understand to evaluate basis and dimension of matrix.
3. Understand to find kernel and image of linear transformation.
4. Understand to represent linear operator as matrix.
5. Understand the orthogonalization of inner product space.
6. Understand the method to find eigen values and eigen vectors.

Unit I **06 Hours**

System of Linear Equation: Vectors and linear combinations, Rank of a matrix, Gaussian elimination, LU Decomposition, Solving Systems of Linear Equations using the tools of Matrices.

Unit II **06 Hours**

Vector Spaces: Definition, linear combination, spanning sets subspaces, linear dependence and independence, basis and dimension, rank of matrix.

Unit III **06 Hours**

Linear Mapping: Linear mapping, Kernel and image of linear mapping, rank and nullity of a linear mapping, singular and non-singular linear mapping

Unit IV **06 Hours**

Linear mapping and matrices: Matrix representation of linear operator, change of base, similarity matrices

Unit V **06 Hours**

Inner Product space and orthogonalization: Inner product space, Cauchy-schwarz equality, orthogonality, orthogonal sets and bases, projections, Grayschist orthogonalization, orthogonal and positive definite matrices, matrix representation of inner produc**t**

Unit VI **06 Hours**

Diagonalization: Eigen values and eigen vectors

Characteristic polynomial, Cayley-Hamilton theorem, eigen values and eigen vectors, properties.

Textbooks/Reference Books

1.P. N. Wartikar and J. N. Wartikar, Applied Mathematics (Volumes I and II), 7th Ed., Pune Vidyarthi GrihaPrakashan, Pune, 2013.

2.B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publication, Delhi

3.B.V. Ramana, Higher Engineering Mathematics, 6th Ed., Tata McGraw-Hill, New Delhi, 2008.

4.Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed., John Wiley & Sons, Inc., 2015.

5.Peter V. O'Neil, Advanced Engineering Mathematics, 7th Ed., Cengage Learning, 2012.

6.Michael Greenberg, Advanced Engineering Mathematics, 2nd Ed., Pearson Education, 1998.

Project Based Learning

Students are expected prepare report on any one topic, write its definition, applications and illustrate with few examples. Also, write pseudo code for it, wherever applicable.

1. Gauss Elimination method.
2. LU-decomposition method
3. Rank of matrix
4. Linear combination
5. Basis and dimension
6. Spanning sets
7. Kernel and image of linear transformation
8. Rank-nullity theorem

9. Non-singular linear mapping
10. Linear operator
11. Similarity matrices
12. Change of base
13. Cauchy Schwarz equality
14. Orthogonality
15. Gram schmidt Orthoginalization
16. Matrix representation of matrix
17. Cayley-Hamilton theorem
18. Eigen values and Eigen vectors

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list.)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Physics for Computing Systems

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
Lecture:	03 Hours/Week	**End Semester Examination:** 60 Marks	**Theory**	03
Practical:	02 Hours/Week	**Internal Assessment:** 40 Marks		
		Term Work: 25 Marks	**Practical:**	01
Total:	05 Hours/Week	**Total:** 125 Marks	**Total:**	04

Course Objectives: To impart knowledge of basic concepts in physics relevant to engineering applications in a broader sense with a view to lay foundation for the Computer Engineering and Science.

Prerequisite: Students are expected to have a basic understanding of physics and calculus.

Course Outcomes: At the completion of the course, the students should be able to**:**

1. Interpret the properties of charged particles to develop modern instruments such as electron microscopy.
2. Appraise the wave nature of light and apply it to measure stress, pressure and dimension etc.
3. Summarise the structure and properties of lasers to their performance and intended applications.
4. Classify the optical fiber, understanding the structure, types and its applications in the field of communication.
5. Solve quantum physics problems to micro level phenomena and solid-state physics.
6. Explain mechanical properties of solid matter, and connect to applications in the field of engineering.

Unit I: Modern Physics **06 Hours**

Motion of a charged particle in electric and magnetic fields, Electrostatic and Magnetostatics focusing, Electron microscope, Wavelength and resolution, Specimen limitation, Depth of field and focus, Transmission electron microscope (TEM), Scanning electron microscope (SEM), Separation of isotopes by Bainbridge mass spectrograph, Cathode ray tube (CRT).

Unit II: Wave Optics **06 Hours**

Interference

Interference of waves, interference due to thin film (Uniform and nonuniform (only formula-no derivation is expected), Newton's ring, Applications of interference (optical flatness, highly reflecting films, non-reflecting coatings).

Diffraction

Introduction, Classes of diffraction, Diffraction at a single slit (Geometrical method), Conditions for maximum and minimum, Plane diffraction grating, Conditions for principal maxima and minima

Polarisation

Introduction, Double refraction and Huygen's theory, Positive and negative crystals, Nicol prism, Dichroism.

Unit III: Lasers **06 Hours**

Principle of laser, Einstein's coefficients, Spontaneous and stimulated emission, Population inversion, Ruby laser, Helium-Neon laser, Semiconductor laser, Single Hetro-junction laser, Gas laser: CO_2 laser, Properties of lasers, Laser speckles, Applications of lasers (Engineering/ industry, medicine, Computers).

Unit IV: **Fibre Optic** **06 Hours**

Principle of fibre optics, Construction, Numerical Aperture for step index fibre; critical angle, angle of acceptance, V number, number of modes of propagation, types of optical fibres, Fibre optic communication system, advantages and disadvantages of fibre optics.

Unit V: Quantum Mechanics **06 hours**

Dual nature of matter, DeBroglie's hypothesis, Heisenberg's uncertainty principle with illustrations, Physical significance of wave function, Schrodinger's time dependant and time independent wave equation, Application of Schrodinger's time independent wave equation to the problems of Particle in a rigid box, step potential and potential barrier (analytical discussion), tunnelling effect.

Unit VI : Solid state physics **06 Hours**

Free electron theory, Density of states, Bloch theorem (Statement only), Origin of band gap, Energy bands in solids, Effective mass of electron, Fermi-Dirac probability function and position of Fermi level in intrinsic semi-conductors

(with derivation) and in extrinsic semi-conductors, Band structure of p-n junction diode under forward and reverse biasing, Conductivity in conductor and semi-conductor, Hall effect and Hall coefficient, Photovoltaic effect, Solar cell and its characteristics.

Textbooks

1. A Textbook of Engineering Physics, M N Avadhanulu, P G Kshirsagar and TVS Arun Murthy, S. Chand Publishing (2018)
2. Engineering Physics, R K Gaur and S L Gupta, Dhanpat Rai Publishing Co Pvt Ltd (2015)
3. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan and S. Rai Choudhury, McGraw Hill Education (2017)

Reference Books

1. Fundamentals of Physics, Jearl Walker, David Halliday and Robert Resnick, John Wiley and Sons (2013)
2. Optics, Francis Jenkins and Harvey White, Tata Mcgraw Hill (2017)
3. Principles of Physics, John W. Jewett, Cengage publishing (2013)
4. Introduction to Solid State Physics, C. Kittel, Wiley and Sons (2004)
5. Principles of Solid-State Physics, H. V. Keer, New Age International (1993)
6. Laser and Non-Linear Optics, B. B. Laud, New Age International Private Limited (2011)
7. Nanotechnology: Principles and Practices, Dr. S. K. Kulkarni, Capital Publishing Company (2014)
8. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan, New Age International Pvt. Ltd. (1997)
9. Introduction to Electrodynamics –David R. Griffiths, Pearson (2013)
10. Renewable Energy: Power for a Sustainable Future, Boyle, Oxford University Press (2012).

List of Laboratory Exercises (Any Eight of the Following)

1. Study of Lissajous figure by Cathode Ray Oscilloscope (CRO)
2. Determination of e/m by Thomson method
3. Determination of radius of planoconvex lens/wavelength of light/Flatness testing by Newton's rings
4. Determination of wavelength of light using diffraction grating
5. Determination of resolving power of telescope

6. Determination of thickness of a thin wire by air wedge
7. Determination of refractive index for O-ray and E-ray.
8. Determination of divergence of a laser beam.
9. Particle size by semiconductor laser.
10. Determination of wavelength of laser by diffraction grating.
11. To study Hall effect and determine the Hall voltage.
12. Calculation of conductivity by four probe method
13. Study of solar cell characteristics and calculation of fill factor.
14. Determination of band gap of semiconductor.
15. Determination of Planck's Constant by photoelectric effect.

List of Assignments

Six assignments to be given by the subject teacher (Theory)-one from each unit/one mini project with report-students can work in group of 4 Maximum.

Project Based Learning

1. Measurement and effect of environmental noise in the college
2. Design and simulation of automatic solar powered time regulated water pumping
3. Solar technology: an alternative source of energy for national development
4. Design and construction of digital distance measuring instrument
5. Design and construction of automatic bell ringer
6. Design and construction of remote-control fan
7. Design and construction of sound or clap activated alarm
8. Electronic eye (Laser Security) as autoswitch/security system
9. Electric power generation by road power
10. Determination of absorption coefficient of sound absorbing materials
11. Determination of velocity of O-ray and E-ray in different double refracting materials
12. Need of medium for propagation of sound wave

13. Tesla Coil

14. Thin film interference in soap film-formation of colours

15. LiFi- wireless data transfer system using light

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list.)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Electrical Technology

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Theory:	04 Hours/Week	End Semester Examination	60 Marks	Theory	04
Practical:	02 Hours/Week	Internal Assessment	40 Marks		
		Term work	25 Marks	Practical	01
		Total	125 Marks	Total	05

Course Objective:

To study of power system basics, magnetic circuits electrical machines, transformers, wiring, measurements, illumination and batteries.

Prerequisite: NIL

-

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the various parameters related to magnetic circuit.
2. Describe basic concepts of AC fundamentals and circuits.
3. Illustrate constructional features and describe different parameters of transformer.
4. Describe basic concepts of power system and three phase circuits.
5. Demonstrate AC and DC electrical machines.
6. Classify types of batteries.

Unit I **08 Hours**

Magnetic Circuits:Magnetic effect of electric current, Cross & Dot Convention, Right hand thumb rule, Concept of flux, flux linkages, magnetic field, magnetic field strength, magnetic field intensity, absolute permeability, relative permeability Kirchhoff's laws for magnetic circuits. Magnetic circuit concepts, analogy between electric& magnetic circuits, magnetic circuits with DC and AC excitations, magnetic leakage, B-H curve, hysteresis and eddy current losses, magnetic circuit calculations, mutual coupling.

Unit II **08 Hours**

AC Fundamentals and circuits:AC Fundamentals: Sinusoidal, square and triangular waveforms – average and effective values, form and peak factors, concept of phasor, phasor representation of sinusoidally varying voltage and

current. Analysis of series, parallel and series-parallel RLC Circuits: apparent, active & reactive powers, power factor, causes and problems of low power factor, power factor improvement; resonance in series and parallel circuits, bandwidth and quality factor (simple numerical problems.

Unit III **08 Hours**

Single Phase Transformer: Faradays law of electromagnetic induction, statically and dynamically induced emf, self-inductance, mutual inductance , coefficient of coupling. Single Phase Transformer: Principle of operation, construction, e .m. f. equation, voltage ratio, current ratio, KVA rating ,determination of efficiency and regulation by direct load test, equivalent circuit, power losses,(simple numerical problems), introduction to auto transformer. Three phase transformer and its different winding connections.

Unit IV **08 Hours**

Introduction to Power System and Three Phase: Circuits: General layout of electrical power system and functions of its elements, standard transmission and distribution voltages, concept of grid (elementary treatment only) Power generation to distribution through overhead lines and underground cables with single line diagram. Three phase system-its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relations, three phase power and its measurement (simple numerical problems).

Unit V **08 Hours**

Electrical Machines: DC & AC:Principles of electromechanical energy conversion, DC machines: types, e. m. f. equation of generator and torque equation of motor, characteristics, and applications of dc motors (simple numerical problems). single Phase Induction motor: Principle of operation and introduction to methods of starting, applications. Three Phase Induction Motor: types, Principle of operation, slip-torque characteristics, applications (numerical problems related to slip only).

Unit VI **08 Hours**

Batteries: Basic idea of primary and secondary cells, Construction, working principle and applications of Lead-Acid, Nickel Cadmium and Silver-Oxide batteries, charging methods used for lead-acid battery (accumulator), Care and

maintenance of lead-acid battery, Series and parallel connections of batteries, General idea of solar cells, solar panels and their applications, Introduction to maintenance free batteries, Safe disposal of Batteries; Fuel cell: Principle & Types of fuel cell.

Textbooks:

1. B.L.Theraja, A Textbook of Electrical Technology, Vol.1, S.Chand& Company Ltd. New Delhi
2. V.K.Mehta, Basic Electrical Engineering, S Chand & Company Ltd. New Delhi.
3. J.Nagarath and Kothari, Theroy and applications of Basic Electrical Engineering, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Electrical Technology - Edward Huges (Pearson
2. Basic Electrical Engineering - D. P. Kothari, J Nagarath (TMC)
3. Electrical power system technology - S. W. Fordo, D. R. Patric (Prentice Hall)
4. Electrical, Electronics Measurements and Instruments - (Satya Prakashan)

List of Assignments:

Six assignments to be given by the course coordinator (Theory)-one from each unit.

List of Laboratory Exercises:

1. Plotting B-H characteristics for a material.
2. Load test on single phase transformer.
3. Testing and maintenance of batteries.
4. Verification of voltage and current relationships in star and delta connected 3-phase networks.
5. Load test on DC machine.
6. To find the performance of series R-L-C circuit at different condition
7. OS & SC test on single phase transformer to find efficiency and regulation
8. Speed control of DC motor
9. Study of different types of starters for DC & AC Machine
10. Load test on 3 phase Induction motor.

Project Based Learning

1. Building a small resistive load lamp bank
2. Building a small resistive load lamp bank for various types of connections like series, parallel, star, delta
3. Building a small inductive load lamp bank for various types of connections like series, parallel, star, delta
4. Building a small capacitive load lamp bank for various types of connections like series, parallel, star, delta
5. Building a small resistive load lamp bank
6. Building a staircase wiring model on a board
7. Building a Go down wiring model on a board
8. Rewinding of a choke
9. Rewinding of a small transformer
10. Building a small rectifier circuit on bread board
11. Building a mobile charger circuit on a bread board
12. Building an electric buzzer circuit
13. Building a solar charger for mobile phone
14. Building a small wind turbine
15. Small Agricultural pump model with DC motor
16. Small Agricultural pump model with AC motor

(Note: - *Students in a group of 3 to 4 shall complete any one project from the above list)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Internet Programming

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Lecture:	04 Hours/Week	**End Semester Examination:** 60 Marks	**Theory:**	04
Practical:	02 Hours/Week	**Internal Assessment:** 40 Marks		
		Term Work: 25 Marks	**Practical:**	01
		Oral : 25 Marks		
		Total: 150 Marks	**Total:**	05

Course Overview

This course content the introduction to all web programming languages with detailed study about HTML, CSS, DHTML, XML and DNS.

Prerequisite:

Students should have basic knowledge about computers, web applications and internet.

Course Outcomes: On completion of the course, students will have the ability to

1. Explain the fundamentals of programming languages.
2. Implementation of Hyper Text Markup Language.
3. Use of Cascading Style Sheets in web page development.
4. Elucidate with implementation of Dynamic Hyper Text Markup Language.
5. Describe with implementation of Extensible Markup Language.
6. Understand and implementation of Hyper Text Transfer Protocol and DNS.

Unit I Introduction to Internet Programming **08 Hours**

Computer Network, working of internet, Web applications, Introduction to web programming languages: HTML, DHTML, JSP, PHP, Role of the Server on the internet, Introduction about Node JS and angular JS.

Unit II Hyper Text Markup Language **08 Hours**

Introduction to HTML, Tags, Div Span, Lists, Images, Hyperlink, Table, Iframe, Form, Headers, all content with HTML 5.

Unit III Cascading Style Sheets **08 Hours**

Introduction to CSS, Syntax, Selectors, background, Text Fonts, Lists Tables, Box Models, Display Positioning, Floats.

Unit IV Dynamic Hyper Text Markup Language **08 Hours**

Introduction of DHTML- HTML vs. DHTML, Advantages of DHTML, CSS of DHTML, Event Handling, Data Binding, Browser Object Models.

Unit V Extensible Markup Language **08 Hours**

Introduction of XML- Features of XML, Anatomy of XML document, The XML Declaration, Element Tags- Nesting and structure, XML text and text formatting element, Table element, Mark-up Element and Attributes, XML Objects, Checking Validity, Understanding XLinks, XPointer, Event-driven Programming, XML Scripting, XML with Style Sheet Technologies- Concept of XSL, XML Schema, Importance of XML schema, Creating Element in XML Schema, XML Schema Types.

08 Hours

Unit VI Hyper Text Transfer Protocol and DNS

DNS, WWW, HTTP, HTTPs, XML HttpRequest- Introduction, XML HttpRequest, The XML HttpRequest Object, Events for the XML HttpRequest Object, Request Object for XML HttpRequest, Response Object for XML HttpRequest, Complete working of web browser

Text / Reference Books

1 HTML & CSS: The Complete Reference, Fifth Edition Paperback by Thomas Powell, McGraw Hill Education.

2 HTML & XHTML: The Complete Reference, by Thomas Powell, McGraw Hill Education, McGraw-Hill Education.

3 XML: The Complete Reference, by Heather Williamson, McGraw Hill Education

4 HTTP Pocket Reference (Pocket Reference (O'Reilly)), Clinton Wong, O′Reilly Publication.

5 HTML & XHTML: The Definitive Guide, 5th Edition, by Bill Kennedy and Chuck Musciano, O'Reilly Publication.

List of Assignments

1. Explain the role of web programming languages in internet.
2. Explain any five HTML tags with example.
3. Consider any web-based example to explain the role of CSS in web programming.
4. Explain the role of DHTML in web programming and web applications.
5. Consider any real time scenario to explain XML.
6. Consider any real time URL and explain its DNS in detail.

5. Implementation of form.
6. Implementation of CSS.
7. Implementation of DHTML.
8. Implementation of XML.
9. Develop the web page with any scenario where HTML, CSS, XML will be used.
10. Develop any web project for any website or any portal.
11. Case Study on web programming languages.
12. Case Study on any web project

Project Based Learning

1. Website Development Hotel management
2. Website Development Personal Website
3. Website Development Organization website
4. Website Development Dummy Ecommerce website
5. Website Development Login page with user credentials
6. Development of a Employee Interests Survey form / Student survey form
7. Technical documentation page
8. Create image slider
9. Railway concession form
10. Website development for personal portfolio

Note: - *Students in a group of 3 to 4 shall complete any one project from the above list

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Programming and Problem Solving

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Lecture:	04 Hours/Week	**End Semester Examination:** 60 Marks	**Theory**	04
Practical:	04 Hours/Week	**Internal Assessment:** 40 Marks		
		Term Work: 25 Marks	**Practical:**	02
		Practical :50 Marks		
		Total: 175 Marks	**Total:**	06

Course Overview

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also, by learning the basic programming constructs they can easily switch over to any other language in future.

Prerequisite:

One can learn C, without ANY knowledge of Algorithms. Basic knowledge of mathematics is required.

Course Outcomes: On completion of the course, students will have the ability to:

1. Describe the problem-solving steps and write a pseudocode for a given problem.
2. Identify the suitable control structure and write a C code for the same.
3. Write the C code for a given algorithm.
4. Illustrate use of pointers and functions
5. Write programs that perform operations using derived data types.

Unit I: Introduction to Computer Problem Solving **08 Hours**

The Problem-solving Aspect, Top Down Design, Implementation of Algorithms, Program Verification, The Efficiency of Algorithms, The Analysis of Algorithms, Fundamental Algorithms:

General problem-solving strategies: Introduction to program Planning tools-algorithm, flowcharts, and pseudo codes. Introduction to Programming Logic.

Unit II: Control structures **08 Hours**

Features of C, basic concepts, structure of C program, program, declarations, variables, data types, expressions, operator's assignment, arithmetic, relational, logical, increment and decrement, precedence of operators, type conversions, scanf and printf functions if-else, nested if-else, ladder if-else and switch statement. C Conditional control structures: for, while do-while Unconditional control structures: break, continue, goto statement

Unit III: Arrays and strings **08 Hours**

Declaration initialization of one-dimensional Array, two-dimensional array, accessing array elements, Character Array/String, Character - Handling Library Functions, Standard Input/Output Library Functions for string.

Unit IV: Functions and structures **08 Hours**

What is a Function, Benefits of a Function, Function Terminology, Array of Structures, How does Function Works, Scope and Lifetime of Variables in function ,Storage Classes of Variables , Call by value and call by reference ,Recursion ,Overview of Structures , Defining and Using a Structure , Structures within a Structure

Unit V: Pointers **08 Hours**

Declaring and Initializing Pointers, Function and Pointer Parameters, Pointer Arithmetic, Pointer and Arrays, Two Dimensional Arrays and Pointers.

Unit VI: Files **08 Hours**

File, Opening and Closing of Files, Writing and Reading in Text Format, Writing and Reading in Binary Format, Command Line Arguments.

Textbooks

1 Let Us C by Yashavant Kanetkar, 13e, BPB Publication.
2.Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI
3.E. Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill
4 How to Solve it by Computer by R. G. Dromey, 1e, Pearson Education.

Reference Books

1 C: The Complete Reference by Herbert Schildt.

List of Assignments (Course coordinator can design his/her own theory assignment. Following are samples of theory assignments.)

1. Write a pseudocode and draw a flowchart for a given problem.
2. Justify the selection of appropriate control structure.
3. Write a function to check whether the string is palindrome.
4. List and explain the working of standard string I/O functions.
5. Define a dynamic array to store the student record.
6. List and explain the different modes of opening file.

List of Laboratory Exercises (Course coordinator can design his/her own practical assignment. Following are samples of practical assignments.)

1. Describe the problem-solving steps
2. Write a pseudocode and draw a flowchart
3. Use mathematical operators and basic data types
4. Demonstrate use of control structures
5. Demonstrate use of logical operators
6. Solve the real time problem using single- and two-dimensional array
7. Perform the operations on string
8. Solve the problems using recursive and non-recursive functions
9. Solve the problems using dynamic memory allocations
10. Perform the operations on files

Project Based Learning

1. Calendar using C
2. Snake Game
3. Cricket score display
4. Quiz game
5. Phone-book application
6. Election System
7. Simple Result system

8. Typing Tutor
9. Bill Calculator
10. Grade Calculator
11. CGPA Calculator
12. Digital Clock
13. Contact Management System
14. IP finder
15. Bank Management System.
16. Departmental Store Management.
17. Hangman Game Project.
18. Library Management System

Note: - *Students in a group of 3 to 4 shall complete any one project from the above list

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Computer System Workshop Technology

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
					Credits
Practical:	02 Hours/Week	**Term Work:** 25 Marks		**Practical:**	01
		Practical: 50 Marks			
		Total:	75 Marks	**Total Credit:**	01

Course Objective:
Provide student a much-needed knowledge of computer hardware and networking, enabling them to identify computer hardware, software and network related problems, and develop an ability to use the basics of computing, necessary for computing courses.

Prerequisite: Basic knowledge of Computer and Electronics.

Course Outcomes: On completion of the course, students will have the ability to:
1. Identify the architecture of a computer and its different components, including their technology evolution.
2. Apply their knowledge about computer peripherals to identify problems.
3. Install and uninstall given software step-by-step.
4. Demonstrate the working of Internet
5. Prepare document using Latex
6. Use GitHub tool for coding and collaboration.

Unit I **04 Hours**

Computer hardware peripherals: Introduction to hardware components, random access memory (RAM), Types Of RAM & their speed, tips for buying

ram, how to add memory to a computer, problems when installing memory, Central Processing Unit (CPU), Types Of CPU: considerations when buying a new CPU (Types & Differences), different speeds available for CPU and what do they mean, 32 Bit vs 64 Bit – Which One To Choose &Why? How to choose a CPU type for different needs? Graphic Card & Types, how to install a Graphics Card, Jumper Switch settings, Hard Disk upgrade, Different ports and why we use them - USB, PS2, DivX, Graphic card & types, Virtual Memory and how to configure it for optimum system performance.

Unit II **04 Hours**

Assembly of Computer and Software Installations: Assembling the motherboard, replacing fan, how to avoid common mistakes during assembly, Installation of system software: Operating system (Windows and Linux), Installations step for operating system, Dual booting, Configure the BIOS, Installation of Antivirus, Installation of the open source software such as Scilab, Latex Installation of MS Office.

Unit III **04 Hours**

Basic Diagnostic of Hardware and Software: Diagnosis of Power Up problem, Boot Drive, Errant Keyboard, mouse problems, slow computer performance, Computer freezes and displays BSOD (Blue screen of death), no display on monitor, no sound, computer rebooting or turning itself off, how to troubleshoot a computer that does not boot, Registry Cleaner.

Unit IV **04 Hours**

Computer network environments: Network connecting devices. Configure the TCP/IP setting, connect to Local Area Network and access the Internet, Configuring Wireless network. Server and Its Configuration, Email Clients, Browsers, Office tools, customize web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers, Browsing netiquettes and cyber laws. Cloud Access Tools.

Unit V **04 Hours**

Configuration of External devices: Physical set-up of Printers- Performing test print out, Printing of document etc, Scanner set-up, Webcam, Bluetooth device, Memory card reader etc

Unit VI **04 Hours**

Productivity tools: Open Source Tools Such as Latex, GitHub

Latex: Format words, lines, and paragraphs, design pages, create lists, tables, references, and figures in LATEX. Introduction to LaTex Packages and classes. Using Git, Version Control Systems, interacting with GitHub, Reverting Changes, Creating Pull Requests.

Textbooks

1. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
2. PC Hardware and A+ Handbook – Kate J. Chase PHI (Microsoft)
3. LaTeX Companion – Leslie Lamport, PHI/Pearson
4. https://nptel.ac.in/courses/106/105/106105081/
5. http://nptel.ac.in/courses/106105084/
6. https://guides.github.com/
7. Introduction to Linux: Installation and Programming, N B Venkateswarlu,BS Publication.

Reference Books

1. IT Essentials PC Hardware and Software Companion Guide Third Edition by David Anfinson and Ken Quamme. – CISCO Press, Pearson Education.
2. Computer Fundamentals, MS Office and Internet & Web Technology by Dinesh Maidasani.

List of Laboratory Exercises

1. Demonstrate the Computer Hardware Components and explain its working.
2. Demonstrate the Networking Components and explain its working.
3. Installation of operating system MS windows, Unix on the personal computer
4. Installation of Application software Scilab, Latex, MS office on the personal computer
5. Troubleshooting hardware related problem.
6. Customize web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
7. Execution of Important “layout” and formatting commands in Latex,

8. Installation of Antivirus and customize the browsers to block pop ups, block active x downloads to avoid viruses and/or worms

Project Based Learning

1. Collect specifications of similar types of hardware and software and prepare report comparing them
2. Assembling and disassembling the PC back to working condition.
3. Installation of operating systems LINUX on Server and different packages on a PC.
4. Practice hardware troubleshooting exercises related to various components of computer like monitor, drives, memory devices, printers etc. and software troubleshooting related to BIOS etc
5. To start your own computer repair workshop. What would your initial planning involve? What would you look for in terms of building, furnishings, tools and any other equipment that you can think of?
6. Cyber Hygiene: Installing antivirus for Windows.
7. Prepare the report of need of programming language in 21st century.
8. Collect various types of computer hardware and prepare summary report
9. Prepare Seminar report using LaTex
10. Prepare Project report using LaText

Note: - *Students in a group of 3 to 4 shall complete any one project from the above list.

B. Tech. CSE (AI & ML)
Semester II Syllabus

Mathematics for Computing-II

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Lecture:	03 Hours/Week	**End Semester Examination:**60 Marks	**Theory:**	03
Tutorial:	01 Hours/Week	**Internal Assessment:** 40 Marks	**Tutorial:**	01
		Total: 100 Marks	**Total:**	04

Course Objectives:

1. Fourier series and integral transforms.
2. Multiple integrals and its applications.
3. Vector calculus and its applications.

Prerequisite: The students should have knowledge of vector algebra, derivative and integration.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand to represents periodic functions as fourier series.
2. Understand methods of finding fourier and Z-transforms.
3. Understand the method of laplace transform of piecewise continuous functions.
4. Understand concepts of double and triple integrals.
5. Understand to vector derivative for physical quantities.
6. Understand to evaluate line, surface and volume integrals.

Unit I **06 Hours**

Fourier Series: Definition, Dirichlet's conditions, Fourier Series and Half Range Fourier Series, Harmonic Analysis

Unit II **06 Hours**

Fourier Transform (FT): Complex Exponential Form of Fourier series, Fourier Integral Theorem, Sine & Cosine Integrals, Fourier Transform, Fourier Sine and Cosine Transform and their Inverses. Introductory
Z-Transform (ZT): Definition, Standard Properties, ZT of Standard Sequences and their Inverses. Solution of Simple Difference Equations.

Unit III **06 Hours**

Laplace Transform and its application: Definition of LT, Inverse LT. Properties & theorems. LT of standard functions. LT of some special functions viz., Periodic, Unit Step, Unit Impulse, ramp, jump, Problems on finding LT & inverse LT. Applications of LT and Inverse LT for solving ordinary differential equations.

Unit IV **06 Hours**

Multiple Integrals and their Application: Double and Triple integrations, Applications to Area, Volume, Mean and Root Mean Square Values, moment of inertia, centre of gravity

Unit V **06 Hours**

Vector Differential Calculus: Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit VI **06 Hours**

Vector Integral Calculus and Applications: Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problem in engineering.

Textbooks/Reference books

1.P. N. Wartikar and J. N. Wartikar, Applied Mathematics (Volumes I and II), 7th Ed., Pune Vidyarthi GrihaPrakashan, Pune, 2013.
2.B. S. Grewal, Higher Engineering Mathematics, 42nd Ed., Khanna Publication, Delhi
3.B.V. Ramana, Higher Engineering Mathematics, 6th Ed., Tata McGraw-Hill, New Delhi, 2008.

4.Erwin Kreyszig, Advanced Engineering Mathematics, 10th Ed., John Wiley & Sons, Inc., 2015.
5.Peter V. O'Neil, Advanced Engineering Mathematics, 7th Ed., Cengage Learning, 2012.

Project Based Learning

Students are expected prepare report on any one topic, write its definition, applications and illustrate with few examples. Also, write pseudo code for it, wherever applicable.

1. Fourier series
2. Harmonic analysis
3. Fourier transform
4. Z-Transform
5. Laplace transform technique to solve ODE
6. Multiple Integral to evaluate area and volume
7. Directional derivative
8. Divergence and curl
9. Greens theorem
10. Gauss Divergence Theorem
11. Stokes theorem
12. Unit step function
13. Solenoidal and irrotational fields
14. Simple difference equation
15. Periodic functions

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list.)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Probability and Statistics

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Lecture:	04 Hours/Week	**End Semester Examination:** 60 Marks	**Theory:**	04
Practical:	02 Hours/Week	**Internal Assessment:** 40 Marks		
		Term Work : 25 Marks	**Practical:**	01
		Practical: 25 Marks		
		Total Marks: 150 Marks	**Total:**	05

Course Objectives:
To Study

1. Probability theory and expected value.
2. Probability distribution and its applications.
3. Multiple regression and ANOVA.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand rank of matrix and test consistency of system of linear equations.
2. Understand to represent periodic function as Fourier series.
3. Understand the methods to find Fourier and Z transform.
4. Understand various numerical technique for ordinary and partial differential equation.
5. Understand the hypothesis techniques.
6. Understand concept of graph and its applications of tree.

Unit I **08 Hours**

Probability Theory: Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes' theorem of inverse probability, Properties of probabilities.

Unit II **08 Hours**

Random Variable and Mathematical Expectation. Definition of random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs, Examples

Unit III **08 Hours**

Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution

Unit IV **08 Hours**

Correlation: Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman's rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient, Properties of Spearman's rank correlation coefficient, Probable errors, Examples.

Unit V **08 Hours**

Linear Regression Analysis: Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

Unit VI **08 Hours**

Multiple Regression and ANOVA: Multiple regression & multiple correlation, Analysis of variance (one way, two way with as well as without interaction).

Textbooks

1.S. C. Gupta, "Fundamentals of Statistics", 46th Edition, Himalaya Publishing House.
2.G. V. Kumbhojkar, "Probability and Random Processes", 14th Edition, C. Jamnadas and co.
3.Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines
4.Kishor S. Trivedi, "Probability, Statistics with Reliability, Queuing and Computer Science Applications", 2nd Edition, Wiley India Pvt. Ltd.
5.Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability And Statistics, 3 rd Edition, Wiley Publication.
6.I.R. Miller, J.E. Freund and R. Johnson.Fun "Probability and Statistics for Engineers" (4th Edition).

List of Assignments

1. Assignment based on Probability Theory.
2. Assignment based on Random Variable and Mathematical Expectation.
3. Assignment based on Theoretical Probability Distributions.
4. Assignment based on Correlation.
5. Assignment based on Linear Regression Analysis.
6. Assignment based on Multiple Regression and ANOVA.

List of Laboratory Exercises (The course coordinator may frame 8-10 experiments)

Project Based Learning

Students are expected prepare report on any one topic, write its definition, applications and analyze the hypothetical data. Also, write pseudo code for it, wherever applicable.

1. Bayes theorem
2. Additive and multiplicative law of probability
3. Mathematical expectation
4. Joint and marginal probability distribution
5. Theoretical probability distribution
6. Coefficient of correlation
7. Regression estimates
8. Simple regression model

9. Multiple regression model
10. One-way ANOVA
11. Two-way ANOVA
12. Correlation
13. Multiple correlation

(Note: - *Students in a group of 3 to 4 shall complete any one project from the above list.)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Organic and Electrochemistry

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lectures:	03 Hours/Week	**End Semester Examination:**	60 Marks	**Theory:**	03
Practical:	02 Hours/Week	**Internal Assessment:**	40 Marks	**Practical**	01
		Term Work: 25 Marks			
		Total: 125 Marks		**Total:**	04

Course Objectives:

The student should acquire the knowledge of

1. To develop the interest among the students regarding chemistry and their applications in engineering.
2. To develop confidence among students about chemistry, how the knowledge of chemistry is applied in technological field.
3. The student should understand the concepts of chemistry to lay the groundwork for subsequent studies in the computing field.

Course Outcomes: On completion of the course, students will have the ability to:

1. Differentiate between ionic and covalent bonding and classify the bonding in a compound as ionic or covalent.
2. Develop a working knowledge of the twelve fundamental principles of green chemistry and what it is all about.
3. Apply standard reduction potential data to determine the relative strength of oxidizing/reducing agents.
4. Demonstrate the knowledge of polymer materials for futuristic engineering applications.
5. Describe the properties of materials and Application of semiconductor electronics

Unit I **06 Hours**

Chemical Bonding in Molecules: MO theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Coordination Chemistry, Electronic spectra and magnetic properties of complexes with relevance to bio-inorganic chemistry, organ metallic chemistry.

Unit II **06 Hours**

Green Chemistry: Introduction, Twelve Principles of Green chemistry, numerical on atom economy, synthesis, adipic acid and indigo. Organic dye-Traditional methods of organic dye. Green solvents (ionic liquid supercritical CO2), and products from natural materials.

Unit III **06 Hours**

Electrochemistry: Electrochemical cells and Galvanic cells, EMF of a cell, Single electrode potential, Nernst equation, Electrochemical series, Types of electrodes, Reference electrodes, pH, pOH, acids and basis, Fuel cells, Construction and Working of - Acid and Alkaline Storage Battery, Dry Cell, Ni-Cd Batteries, Li-Ion Batteries, Li-Po Batteries.

Unit IV **06 Hours**

Polymers for the Electronics Industry: Polymers, Conduction mechanism, Preparation of conductive polymers, Polyacetylene, Poly (p-phenlylene), Polyhetrocyclic systems, Polyaniline Poly (Phenylene sulphide), Poly (1,6-heptadiyne), Applications, Photonic applications.

Unit V **06 Hours**

Semi-Conductors, Insulators and Superconductors: Semi conductivity in non-elemental materials, Preparations of semiconductors, Chalcogen photoconductors, photocopying process Introduction to Superconductors, types of Superconductors, Properties of superconductors, Applications of Superconductors, Electrical insulators, or Dielectrics.

Unit VI **06 Hours**

Fuels and Lubricants: Classification of fuels, Calorific values, Comparison between solid, liquid and gaseous fuels, Theoretical calculation of calorific

value of a fuel, Selection of coal, analysis of coal, Natural Gas, Producer gas, water gas, Lubricants, Mechanism of lubrication, classification of lubricants, lubricating oils, Solid lubricants, Greases or Semi-Solid lubricants, Synthetic lubricants, Lubricating emulsions, Properties of lubricating oils.

Textbooks

1. Polymer Science and technology (2nd Edition), P. Ghosh, Tata McGRAW Hill, 2008.
2. Polymers: Chemistry & Physics of Modern Materials (2nd edition) J.M.G.Cowie, Blackie Academic & Professional, 1994.
3. A Text Book of Engineering Chemistry, Shashi Chawla, Dhanpat Rai & Co, 2004
4. Engineering Chemistry (16th Edition) Jain, Jain, Dhanpat Rai Publishing Company, 2013.
5. Inorganic Chemistry (4th edition), D. F. Shrives and P. W. Atkins, Oxford University, Oxford, 2006.
6. Applications of Absorption Spectroscopy of Organic Compounds (4th edition), John R. Dyer, Prentice Hall of India Pvt. Ltd., 1978.
7. Reactions, Rearrangements and Reagents (4th edition), S. N. Sanyal, Bharti Bhawan (P & D), 2003.

List of Laboratory Exercises

1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. To determine strength of acid by pH – metric Titration
4. To measure the Conductance of a solution by conductometric titration
5. Measurement of Surface tension of a given liquid by Stalgmometer.
6. Determination of viscosity of a given liquid by Ostwald's Viscometer.
7. Determination of Saponification value of an oil sample.
8. To determine alkalinity water sample.
9. Determination of Hardness of water sample by EDTA method.
10. Determination of Chloride content in water sample by precipitation titration method.
11. To determine strength of acid by pH – metric Titration
12. To Prepare Phenol formaldehyde/Urea formaldehyde resin.

Project Based Learning

1. Green Chemistry approach to Nano-Structured Electronics.
2. Assessment of Environmentally Benign Photopolymers as an Alternative to the Use of Formaldehyde Based Textile Finishing Agents
3. Solvent-Free Synthesis of Phthalocyanines
4. Synthesis of Conjugated Polymers and Molecules Using Sugar Reagents and Solventless Reactions
5. Environmentally Benign Control of Polymer Solubility: Photoresist Materials Using DNA Mimics
6. Enzymatic Synthesis of Non-Formaldehyde Phenolic Polymers: Control of Hydrogen Peroxide Concentration.
7. The materials chemistry and electrochemistry of lithium and sodium-ion batteries
8. Electroplating- the principles, how different metals can be used and the practical applications.
9. Electroplating, Metal Polishing, Anodizing, Phosphating Metal Finishing and Powder Coating Projects.
10. To determine calorific value of a fuel by any suitable method
11. To study various properties of lubricants
12. To study various types of lubricants and its properties.
13. To determine quality of coal sample & its analysis.
14. To study mechanism of lubrication.
15. To study coal analysis & its significance.

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list.)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit –V, Unit – VI

Digital Electronics

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lectures:	04 Hours/Week	**End Semester Examination:**	60 Marks	**Theory:**	04
Practical:	02 Hours/Week	**Internal Assessment:**	40 Marks		
		Term Work:	25 Marks	**Practical**	01
		Total:	125 Marks	**Total:**	05

Course Objective:

1. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
2. To familiarize with the design of various combinational digital circuits using logic gates
3. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
4. To understand the various semiconductor memories and related technology

Prerequisite: Physics, Mathematics, Basics of electrical engineering

Course Outcomes: On completion of the course, students will have the ability to:

1. Comprehend different number systems and Boolean algebraic principles.
2. Apply logic design minimization techniques to simplify Boolean expressions
3. Analyse and design combinational logic circuits.
4. Demonstrate the operations of systems with sequential circuit elements.
5. Comprehend characteristics and structure of Programmable Logic Devices and Memory.

Unit I **08 Hours**

Digital systems:

Number Systems: Introduction to Number Systems-Decimal, Binary, Octal, Hexadecimal, Conversion of number system, Representation of Negative Numbers, 1's complement and 2's complement. Binary Arithmetic: Binary addition, Binary subtraction, Subtraction using 1's complement and 2's complement, Binary multiplication, and division. Digital Codes: BCD code, Excess-3 code, Gray code and ASCII code. Logic Gates: Logical Operators, Logic Gates-Basic Gates, Universal Gates, realization of other gates using universal gates.

Unit II **08 Hours**

Logic Design Minimization: Boolean algebra, De Morgan's Theorems, Standard representation of logic functions, Sum of Product (SOP) form, Product of Sum (POS) form, Simplification of logical functions, Minimization of SOP and POS forms using Karnaugh-Maps up to 4 variables Don't care condition, Quine-McCluskey Method.

Unit III **08 Hours**

Combinational Circuits: Binary and BCD arithmetic, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Code converters

Multiplexers, De multiplexer, Decoder (IC 74138) and their use in combinational logic design, Priority Encoder, Digital Comparators, Parity generators and Checker (IC 74180), ALU

Unit IV **08 Hours**

Sequential Circuits: Flip- flop: SR, JK, D, T flip flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flip Flop.

Registers: Buffer register, Shift register.

Counters: Asynchronous counters, Synchronous counters, Modulus counters

Unit V **08 Hours**

FSM and ASM charts: Introduction to FSM, Moore and Mealy State machine, state machine as a sequential controller. Design of state machines: state table, state assignment, transition/excitation table, excitation maps and equations, logic realization, ASM chart notations, ASM block, State diagram, ASM chart for sequential circuits, Multiplexer Controller.

Unit VI **08 Hours**

Memory and PLD: Semiconductor memories: memory organization, memory expansion, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM Programmable logic devices: Study of PROM, PAL, PLAs. Architecture of PLA, designing combinational circuits using PLDs.

Textbooks

1. M. Morris Mano and M. D. Ciletti, Digital Design, Pearson Education.
2. RP Jain, Modern Digital Electronics, Tata McGraw Hill Publication.
3. F.J. Hill and G.L. Peterson, Switching Theory and Logic Design, John Wiley
4. J.F.Wakerly "Digital Design: Principles and Practices", 3rd edition, 4th reprint, Pearson Education, 2
5. David J. Comer, Digital Logic & State Machine Design, Oxford University Press.
6. Digital Integrated Electronics- H.Taub & D.Shilling, Mc Graw Hill.

List of Assignments

Six assignments to be given by the course coordinator (Theory)-one from each unit

List of Laboratory Exercises

1. Verify truth tables of logic gates. (AND, OR, XOR, NOT, NAND, NOR). Simplify the given Boolean expression using K-map and implement using gates
2. State De-Morgan's theorem and write Boolean laws. Implement NAND and NOR as Universal gates.
3. Design (truth table, K-map) and implement half and full adder/ subtractor.
4. Design (truth table, K-map) and implement 4-bit BCD to Excess-3 Code converters.
5. Study of magnitude Comparator using IC 7485
6. Implement of logic functions using multiplexer IC 74151 (Verification, cascading & logic function implementation)
7. Implement logic functions using 3:8 decoder IC 74138.

8. Verify truth tables of different types of flip flops.
9. Design (State diagram, state table & K map) and implement 3 bit Up and Down Asynchronous and Synchronous Counter using JK flip-flop

Project Based Learning

1.Survey report of basic gates ICs 7432, 4011, 4050, 4070,4071,4010
2. Implement combinational logic Circuit of given Boolean Equation.
3. Implement Half Adder and Half Subtractor.
4. Implement Full Adder using two Half Adders
5. Build 4-bit parallel Adder / Subtractor using IC.
6. Build Code Converters: Binary to Gray
7. Build Code Converters: Excess 3 to Binary)
8. Implement Two Bit Magnitude Comparator using IC 7485
9. Implement given combinational logic using MUX
10. Implement 7 segment decoder driver using IC 7447.
11. Build a Decade counter and Up-Down Counter.
12. Build a Shift Registers: SISO and SIPO
13. Implement the Johnson Counter and Ring Counter.
14.Survey Report on Static I/O and transfer Characteristic of TTL and CMOS.
15. Implement given Boolean Function using PLA.
(Function and Equation will be given by Subject Teacher)

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit –V, Unit – VI

Object Oriented Programming

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
Lecture:	04 Hours/Week	**End Semester Examination:** 60 Marks	**Theory:**	04
Practical:	04 Hours/Week	**Internal Assessment:** 40 Marks		
		Term Work: 25 Marks	**Practical:**	02
		Practical :50 Marks		
		Total:175 Marks	**Total:**	06

Course Objectives -:
It covers Object Oriented Concepts through Java Programming language and it also covers Multiprogramming and Exception Handling.

Prerequisite: C Programming

Course Outcomes: At the end of the course, the students should be able to**:**

1. To apply fundamental programming constructs.
2. To illustrate the concept of packages, classes and objects.
3. To elaborate the concept of strings, arrays and vectors.
4. To implement the concept of inheritance and interfaces.
5. To implement the concept of exception handling and multithreading.
6. To develop GUI based application.

Unit I: Introduction to Object Oriented Programming **08 Hours**

OOP concepts: History and Features of Java, Difference between Procedural and Object-Oriented Programming, Objects, class, Encapsulation, Abstraction, Inheritance, Polymorphism, message passing, Java Virtual Machine, Basic programming constructs: variables, data types, operators, unsigned right shift operator, expressions, branching and looping.

Unit II: Class, Object, Packages and Input/output **08 Hours**

Class, object, data members, member functions Constructors, types, static members and functions Method overloading Packages in java, types, user defined packages Input and output functions in Java, Buffered reader class, scanner class

Unit III: Array, String and Vector **08 Hours**

Array, Strings, String Buffer and its Constructors, Vectors, Methods of the Vector Class, Constructor of Vector.

Unit IV: **Inheritance and Polymorphism** **08 Hours**

Use of Inheritance, Types of Inheritance in Java, Role of Constructors in inheritance, Polymorphism in OOP, Types of Polymorphism, static and dynamic polymorphism, Overriding Super Class Methods. Use of "super" keyword. Interfaces, Implementing interfaces.

Unit V: Exception handling and Multithreading **08 hours**

Exception handling using try, catch, finally, throw and throws, Multiple try and catch blocks, user defined exception Thread lifecycle, thread class methods, creating threads using extends and implements keyword.

Unit VI: GUI programming in JAVA **08 Hours**

Applet and applet life cycle, creating applets, graphics class functions, parameter passing to applet, Font and Color class. Event handling using event class AWT: working with windows, using AWT controls for GUI design Swing class in JAVA.

Textbooks

1. Herbert Schildt, 'JAVA: The Complete Reference', Ninth Edition, Oracle Press
2. E. Balagurusamy, 'Programming with Java', McGraw Hill Education.

Reference Books

1. Ivor Horton, "Beginning JAVA", Wiley India.
2. Dietal and Dietal, "Java: How to Program", 8th Edition, PHI .
3. "JAVA Programming", Black Book, Dreamtech Press.
4 "Learn to Master Java programming", Staredu solutions

List of Assignments (Course coordinator can design his/her own theory assignment. Following are samples of theory assignments.)

1. Explain the Object-Oriented Concepts in detail.
2. Illustrate the Constructor, Method Overloading. Explain use of Scanner Class.
3. Explain the Strings and Vector Class Methods with suitable example.
4. Define the Abstract Class and Abstract methods with suitable example.
5. Define Exception. Explain the Try, Catch and Finally keyword.
6. Explain Applet and AWT Package with its Classes.

List of Laboratory Exercises (Course coordinator can design his/her own practical assignment. Following are samples of practical assignments.)

1. Programs on Basic programming constructs like branching and looping
2. Program on accepting input through keyboard.
3. Programs on class and objects
4. Program on method and constructor overloading.
5. Program on Packages.
6. Program on 2D array, strings functions
7. Program on String Buffer and Vectors
8. Program on types of inheritance
9. Program on Multiple Inheritance
10. Program on abstract class and abstract methods.
11. Program using super and final keyword.
12. Program on Exception handling
13. Program on user defined exception
14. Program on Multithreading
15. Program on Graphics class
16. Program on applet class
17. Program to create GUI application
18. Mini Project based on the content of the syllabus (Group of 2-3 students)

Project Based Learning

1. Smart City Project
2. Currency Converter
3. Online Exam Project in Java

4. Moving Balls mini project using Java Applet
5. Text Editor in Java using AWT controls.
6. Album Manager Project in Java
7. Vehicle Management System in Java
8. Music Player project in Java
9. Student Management System Project in Java
10. Simple Calculator project in Java
11. Image to PDF Convertor in java
12. Simple Chat System
13. Online Quiz project
14. Pong game in java
15. Tokenize implementation.

(Note: - *Students in a group of 3 to 4 shall complete any one project from the above list)

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Server-Side Scripting Language

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
				Credits
Practical:	02 Hours/Week	**Term Work:** 25 Marks **Practical :** 50 Marks **Total:** 75 Marks	**Practical:** **Total:**	01 01

Course Objectives:
The objective of this course is to impart students with the knowledge to setup the development environment, design and develop dynamic database driven web applications using PHP.

Prerequisite: Internet Programming

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand the basics of PHP Programming.
2. Design interactive forms using PHP.
3. Implement various operations on arrays and control structures.
4. Create database and show the database connectivity.
5. Implement cookies and session.
6. Develop dynamic web content.

Unit I: Introduction to web **4 Hours**

Introduction to web technology, Web application, Web server, Client and Server, Scripting languages.

Unit II: Basics of PHP **4 Hours**

PHP Basics, Introduction, XAMPP & WAMPP, Configure php.ini, PHP Syntax, Variables, Strings, Constants, Operators, Echo / Print, If....Else.....Elseif , Switch.

Unit III: Functions in PHP **4 Hours**

Loops, For, Foreach, While, Functions, string functions - introduction, user defined functions, Strings & Patterns, Quoting, Matching, Extracting, Searching, Replacing, Formatting, PCRE ▪ NOWDOC, Encodings.

Unit IV: Arrays in PHP **4 Hours**

Arrays, Introduction, Array syntax, Array Index, get length without using pre-defined functions, Array push and pull, Associative arrays, loop through arrays, Multidimensional Arrays, Array functions, Array Sorting without using pre-defined functions, Introduction to PostgreSQL.

Unit V: Interacting with database **4 Hours**

Understand MySQL, simple SQL, retrieval, PHP database functions.

Unit VI: Session and cookies in PHP **4 Hours**

Sessions - introduction, Start a PHP session, session variables, modify session, destroy session, Cookies, Start a PHP Cookies, Cookie variables , modify Cookie ,destroy Cookie.

Text Books

1. Learning PHP, MySQL & Javascript, Robin Nixon, OREILLY, 4th Editon, 2015
2. Head First PHP & MySQL-Lynn Beighley & Michael Morrison-O'Reilly
3. PHP: A Beginner's Guide-Vikram Vaswani- McGraw-Hill Education.

Reference Books

1. The Complete Reference PHP – Steven Holzner, Tata McGraw-Hill
2. The Joy of PHP Programming: A Beginner's Guide – Alan Forbes, BeakCheck LLC,6th edition

List of Laboratory Exercises (Course coordinator can design his/her own practical assignment. Following are samples of practical assignments.)

1. Write a PHP function to count total number of vowels from the string. Accept a string using HTML form.
2. Write a PHP script to print Fibonacci series.
3. Create a student registration form using text box, check box, radio button, select, submit button. Display the user inserted value in new PHP page.
4. Write a program to perform the following operations on an associative array.
   i) Display elements of an array along with their keys.
   ii) Display size of array.
   iii) Delete an element from an array from the given index.
5. Write a Program to insert a roll no and student name in a database (use PostgreSQL data to create a database).
6. Write PHP script to demonstrate passing variables with cookies.
7. Implement Admin login/logout functionality and cookie wherever required.
8. Write a PHP script to connect MYSQL server from your web application.
   Write a PHP script to create and drop database.
9. Create database using phpMyAdmin. Write a program to read input data from table and display the information in tabular form.
10. Develop PHP application using forms and database.
11. Mini Project

Project Based Learning

1. To create a PHP-powered web portal that needs no authentication for visitors to view the information published.
2. To develop a website offering car renting services.
3. Develop a converter program for the area, length, speed, temperature, volume, and weight.
4. To create a social network like Facebook.
5. To create a website having songs and related information, such as personnel details, duration, genre, etc.

6. To develop a simple and effective web-based photo editor with editing, selection, and positioning photos as well as to prepare publication-ready images.
7. To develop a small tool for customer relationship management.
8. To develop Time Table Generator
9. To collect, organize, and manage student information effectively.
10. Online School Administration Management System
11. Online Paying Guest Accommodation Project
12. College Admission Predictor
13. ERP System for College Management
14. CRM For Internet Service Provider
15. Online Blood Bank Project
16. Movie Success Prediction Using Data Mining
17. Web-based Chat Application with Webcam
18. College Social Network Project
19. Canteen Food Ordering and Management System
20. Fake Product Review Monitoring & Removal for Genuine Ratings

Note: - *Students in a group of 3 to 4 shall complete any one project from the above list

(Sub. Code)	Algorithms Analysis and Design	4L:2P:0T	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes:

At the end of the course learner will be able to

1. Interpret the performance of algorithms using analysis techniques.
2. Describe, apply and analyze the complexity of Divide and Conquer strategies.
3. Describe, apply and analyze the complexity of Greedy Methods.
4. Describe, apply and analyze the complexity of Dynamic Programming Approach.
5. Implement graphs and tree algorithms and String-Matching Algorithms.
6. Summarize the advanced types of algorithms and Complexity class.

Unit 1: Introduction (8 hours):
Performance analysis, space, and time complexity Growth of function, Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour.
Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

Unit 2: Divide and Conquer Approach: (8 hours)
General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Binary search and Analysis, Strassen's Matrix multiplication.

Unit 3: Greedy Method Approach: (8 hours)
General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms**,** Ford-Fulkerson algorithm, Huffman Coding.

Unit 4: Dynamic Programming Approach: (8 hours) General Method, Multistage graphs, all pair shortest path: Floyd Warshall Algorithm, Network Flow Algorithm, Assembly-line scheduling Problem, 0/1 knapsack Problem, Travelling Salesperson problem, longest common subsequence.

Unit 5: Graph Theory and String-Matching Algorithms: (8 hours)
Graph and Tree Algorithms: Self-Balancing tree, B Trees, B+ Trees, Single source shortest path: Bellman Ford Algorithm.
String Matching Algorithms: The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm.

Unit 6: Advance Strategies: (6 hours)
Approximation algorithms, Randomized algorithms, Introduction to Quantum Algorithms and parallel algorithms. Complexity class: Definition of P, NP, NP-Hard, NP-Complete.

Text Books:

1. “Fundamentals of Computer Algorithms”, E. Horowitz and S. Sahni, Orient Black.
2. “Introduction to Algorithms”, T. H. Cormen, C. E. Leiserson and R. L. Rivest,PHI Learning Pvt. Ltd. (Originally MIT Press).
3. “The Design and Analysis of Computer Algorithms”, A. Aho, J. Hopcroft and J. Ullman, Pearson Education India.
4. Computer Algorithms: Introduction to Design and Analysis, S. Baase, Pearson Education India.
5. “The Art of Computer Programming”, D. E. Knuth, Addison Wesley.

Reference Book:

1. M. Welss, “Data Structures and Algorithm Analysis in C++", Pearson Education, ISBN-81-7808-670-0.
2. G. A.V, PAI, “Data Structures and Algorithms “, McGraw Hill, ISBN -13: 978-0-07-066726-6.

Theory Subject Assignments:

Each assignment should have 3 questions.

Lab Experiments list:

1. Discuss the different types of sorting techniques.
2. Write and analyze code to sort an array of integers using merge sort.
3. Write and analyze to sort an array of integers using divide and conquer quick sort Method.
4. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
5. Write a program to Implement 0/1 Knapsack problem using Dynamic Programming.
6. Write a program to implement the Longest Common Subsequence problem using Dynamic Programming.
7. Write a program to Implement N Queens problem using Backtracking.
8. Write a Code to find the shortest path using Bellman-Ford algorithm.
9. Write a program to implement quick sort using randomized algorithm.
10. Write a program to implement a network flow algorithm.

Subject Assignments (Project Topics):

1. Design and develop a project for Search engine using data structures.
2. Design and develop a project for Google form like application.
3. Design and develop a project for shortest path calculation for travelling salesman Problem.
4. Design and develop a project for finding keywords from the paragraph.
5. Design and develop a project for Customer Billing system.
6. Design and develop a project for word dictionary using search tree concept.
7. Design and develop a project for salary calculation of employees based on performance.
8. Design and develop a project for password recovery system
9. Create a mini project to construct a game: Create Sudoku.

(Sub. Code)	Python Programming	4L:0T:2P	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. To understand basic concepts in python.
2. To explore contents of files, directories and text processing with python.
3. To develop program for data structure using built in functions in python.
4. To explore Django web framework for developing python-based web application.
5. To understand Multithreading concepts using python.

Unit 1: Python basics (6 hours):

Data types in python, Operators in python, Input and Output, Control statement, Arrays in python, String and Character in python, List and Tuples, Dictionaries Exception.

Unit 2: Advanced Python (6 hours):

Functions, Introduction to OOP, Classes, Objects, Interfaces, Inheritance.

Unit 3: Data Structure in Python (6 hours):

Files in Python, Directories, Building Modules, Packages, Text Processing, Regular expression in python.

Unit 4: Python Integration Primer (6 hours):

Graphical User interface, networking in Python, Python database connectivity.

Unit 5: Multithreading (6 hours):

Thread and Process, starting a thread, threading module, Synchronizing threads, Multithreaded Priority Queue.

Unit 6: Django (6 hours):

Django Overview, Django Installation, creating a project, creating an application, Understanding folder structure, Database and views, API and Security.

Text/Refence Books

1. Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
3. Anurag Gupta, G. P. Biswas, “Python Programming”, McGraw-Hill.

4. E. Balagurusamy, “Introduction to computing and problem-solving using python”, McGraw Hill Education.

Reference book:

1. Learn Python the Hard Way, 3rd Edition, Zed Shaw's Hard Way Series.
2. Laura Cassell, Alan Gauld, “Python Projects”, Wrox Publication.

Theory Subject Assignments:

(Unit wise minimum 3 questions.)

Lab Assignment:

(Minimum 10 lab assignments)

1. Exploring basics of python like data types (strings, list, array, dictionaries, set, tuples) and control statements.
2. Creating functions, classes and objects using python. Demonstrate exception handling and inheritance.
3. Exploring Files and directories a. Python program to append data to existing file and then display the entire file b. Python program to count number of lines, words and characters in a file. c. Python program to display file available in current directory
4. Creating GUI with python containing widgets such as labels, textbox, radio, checkboxes and custom dialog boxes.
5. Menu driven program for data structure using built in function for link list, stack and queue.
6. Program to demonstrate CRUD (create, read, update and delete) operations on database (SQLite/ MySQL) using python.
7. Creation of simple socket for basic information exchange between server and client.
8. Creating web application using Django web framework to demonstrate functionality of user login and registration (also validating user detail using regular expression).
9. Programs on Threading using python.
10. Mini Project based on the content of the syllabus (Group of 2-3 students).

(Sub. Code)	Data Structure (Subject Name)	4L:0T:2P	05 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Use appropriate data structure to solve a particular problem
2. Demonstrate the use of linked list and compare it with array.
3. Demonstrate the use of stack as an ADT.
4. Perform the operations on queue.
5. Apply the searching and sorting algorithms
6. Demonstrate the use of Files and different File Organizations

Unit I (8 hours)

Introduction to Data structures: Introduction to algorithm, Algorithm analysis, Big O Notations, Need of Data structure, Classification of Data Structures, Operations on Data Structures. **Arrays:** Introduction, Array Operations, representation of Arrays in Memory, One- & Two-dimensional array in function, Implementation of One- & Two-Dimensional Arrays in Memory, Abstract Data Types.

Unit II (8 hours)

Linear Lists: Introduction, Singly linked list, Circularly Linked List, Doubly Linked lists, Basic operations, - Insertion, Deletion, retrieval, traversal, create List, insert node, delete node, List Search, Empty list, Destroy list, Applications of Linked List.

Unit III (8 hours)

Stacks: Stack Structure, Operations on Stacks – create stack, Push stack, Pop stack, Array and Linked Representation, operations (For both array and Linked representation), Types of Notations, Applications of Stack: Reversing Data, Converts Decimal to Binary, Parsing, Postponement.

Unit IV (8 hours)

Queue: Introduction, Definition, Storage Methods Queue Operations- Enqueue, Dequeue, Queue front, Queue rear, Queue Example, Create Queue, priority Queue, Circular Queue, Application of Queue: Categorising Data, Queue. Simulation, Array and Linked representation of queue (operations on array and Linked representation.

Unit V (8 hours)

Implementation &Application: Searching: Linear Search, Binary Search, Hashing: Introduction. Hash Tables, Hash Functions, Collision, Applications, Sorting – Selection Sort, Bubble Sort, Insertion Sort, Merge Quick Sort, Shell Sort.

Unit VI (8 hours)

Files and Organization: Introduction, Data Hierarch, File Attributes, Text and Binary Files, Basic File Operations, File Organization, Sequential Organization, Relative File Organization, Indexed Sequential File `Organization.

Textbooks

1. Richard F Gilberg & Behrouz A Forouzan, Data Structures (A Pseudocode Approach with C), second edition, Cengage Learning, 2004.
2. PAI, Data Structures, Tata McGraw-Hill Education, 2008
3. Data Structures Using C, Reema Thareja, OXFORD University Press

Reference Book:

1. Mayank Patel, Data Structure and Algorithm With C, Educreation Publishing, 2018
2. Thomas H. Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2001.

Theory Subject Assignments:

List of Assignments: (Unit wise minimum 3 questions.)

1. Write an algorithm for a given problem and analyse it's complexity
2. Describe representation of a linked list in the memory and write a pseudo code to perform deletion operation on list.
3. Illustrate the use of stack to solve the Tower of Hanoi problem.
4. Write a pseudo code to perform operations on priority queue.
5. Compare bubble sort and selection sort
6. Describe the sequential file organization.

Lab Assignment:

(Minimum 10 lab assignments)

1. Use of array and operations on Array.
2. Operations on singly and doubly linked list.
3. Polynomial operations using linked list.
4. Create stack and demonstrate its use.
5. Develop a priority queue and perform the operations.
6. Demonstrate the use of different file organizations.

Subject Code	Computer Organization and Microprocessor	4L:0T:2P	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Explain the architecture and functions of Central Processing Unit.
2. Solve fixed point and floating-point arithmetic problems using algorithms
3. List the design approaches and functional requirements for implementing control unit.
4. Analyze the characteristics of memory system.
5. Describe the I/O organization and interconnections.
6. Infer parallel processing and multiprocessor configuration.

Unit 1: Introduction to x86 architecture (8 hours):
Revision of basics in Boolean logic and Combinational/Sequential Circuits.
Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Introduction to x86 architecture.
Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

Unit 2: Data Representation and Computer Arithmetic (8 hours):
Data representation: Signed number representation, fixed and floating-point representations, character representation.

Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

Unit 3: CPU Control Unit Design (8 hours):
Hardwired Control Unit – State table, Delay Element and Sequence Counter Method
Microprogrammed Control Unit – Micro program, Nano Program.

Unit 4: Memory System (8 hours):
Memory system design: Semiconductor memory technologies, memory organization. Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Unit 5: Peripheral Devices (8 hours):
Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software

interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCSI, USB.

Unit 6: Pipelining and Parallel Processing (6 hours):

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Text/Refence Books

1. Computer System Architecture M. M. Mano:, 3rd ed., Prentice Hall of India, New Delhi, 1993.
2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy.
3. Computer Organization and Embedded Systems, Carl Hamacher.

Reference Book:

1. Computer Architecture and Organization, John P. Hayes.
2. Computer Organization and Architecture: Designing for Performance, William Stallings.

Lab Assignment:

1. Internal of Computer.
2. Case study on different Microprocessor.
3. ALP on 8086 operations.
4. Transfer a block of data from one segment to other.
5. Scan the segment to identify a string.
6. Booth's algorithm for multiplication.
7. Restoring and non-restoring division.
8. Fixed point and floating-point representation.
9. Interrupt and their handling.
10. Cache organization and address mapping.

Course code	Course name	L: P: T	Credits
	Database Management Systems	**3:2:0**	**4**

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Theory:	**03 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**03**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

COURSE OUTCOMES

Students will be able to

1. Understand various database management systems and data models
2. Design normalized database system
3. Apply the operation of relational data model and write SQL queries.
4. Analyse the indexing techniques for query processing

Course Contents

UNIT I: Overview of DBMS (06 Hours)

Overview of Database management System, Database System Architecture, File systems Advantages of DBMS, View of data, levels of data abstraction, Instances and Schemas, Data Models, Database Languages, Role of DBA.

UNIT II: Database Design (06 Hours)

Entity Relationship Model:

Constraints, Design Issues, Weak Entity Sets, attributes, Extended ER features, Integrity constraints, Key constraints, Participation constraints, ER-EER to Relational mapping. Subclasses and inheritance, Specialization and Generalization, Modelling of UNION types using categories.

UNIT III: Query processing: (06 Hours)

DDL: Create, Modify, Alter, Drop, View definition, etc.

DML: SELECT, INSERT, DELETE, Update, Nested Query, SQL with SET operations, Aggregate Functions, Nested and Complex Queries, Join Queries. DCL: GRANT, REVOKE.

Cursors and Triggers: Exception Handling, PL/SQL Subprograms – Procedures and Functions; PL/SQL Packages.

UNIT IV: Normalization (06 Hours)

Functional dependencies, Armstrong's axioms, Closure, finding primary keys using FDs, Normal forms: 1NF, 2NF,3NF, Boyce-Codd Normal Forms, Multi-values dependencies and fourth normal form, Join dependencies and fifth normal form, Inclusion dependencies, Properties of decompositions.

Transaction & Concurrency Control: Transaction concept, ACID properties, Conflict & View serializability, Test for Conflict serializability, Concurrency Control, Lock base protocols, two phase locking.

UNIT V: Relational Query Language (06 Hours)

Relational Algebra: Selection, Projection, Set operations, Renaming, Joins, Division, Subtraction.

Relational Calculus: Tuple relational calculus, Domain relational calculus.

Integrity Constraints & Introduction to RDBMS, Domain Constraints, Referential Integrity Constraints, Codd's rule.

UNIT VI: Storage and Indexing: (06 Hours)

Storage structures: Secondary storage devices, buffering of blocks, Basic file systems – File organization – Serial, Sequential, Indexed Sequential, Searching, Clustered Indexing, Primary & secondary indexes, Hash based indexing, Tree Based Indexing, hashing techniques, B+ tree-based files.

Distributed Databases: Basic Concepts, Data Fragmentation, Replication and Allocation Techniques, Types of Distributed Database Systems, Query Processing, Overview of Client-Server Architecture and Its relationship to Distributed Databases.

Lab Experiments:

1. DDL and DML statements for table, view, sequence and various data types.
2. Adding primary key, foreign key, check constraints for tables.
3. Alter table command for adding columns, adding and dropping constraints.
4. SQL Queries, WHERE clause, relational, logical and arithmetic operators, UNION, INTERSECTION and MINUS operators.
5. Joins in queries, Cartesian product, Inner Join, Natural Join, Outer join.
6. Nested sub queries, Use of IN, EXISTS.
7. Queries using aggregate operators like MAX, MIN, COUNT, SUM etc, HAVING, GROUP BY and ORDER BY clause.
8. Creating Triggers on tables, Row level and statement level triggers.
9. Creating Indexes on tables.

Text Books:

1. Elmasri and Navathe, "Fundamentals of Database System", 5th Edition, Addison Wesely Publication. (2006).

2. Abraham Silberschatz, Henry Korth, Sudarshan, “Database System Concepts”, 6th Edition, (2010).
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, Second Edition, McGraw-Hill, 2002.

Reference Books:

1. Peter Rob and Coronel, “Database systems, Design, Implementation and Management”, 5th Edition, Thomson Learning,2001.
2. C. J. Date,”An Introduction to Database Systems”, 8/e, Pearson Education,2002.

Theory Subject Assignments:
(Unit wise minimum 3 questions.)

Lab Assignment:
(Minimum 10 lab assignments)

	THEORY OF COMPUTATION	3L:1T:0P	3 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**03Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**03**
Practical:	**---**	**Internal Assessment**	**40 Marks**		
				Tutorial	**01**
		Total	**100 Marks**	**Total**	**04**

COURSE OBJECTIVES:

1. To give an overview of the theoretical foundations of computer science from the perspective of formal languages
2. To illustrate finite state machines to solve problems in computing
3. To explain the hierarchy of problems arising in the computer sciences.
4. To familiarize Regular grammars, context frees grammar.

Prerequisites:

Students entering this course should have a strong background in discrete mathematics, data structures, and algorithms.

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

1. To use basic concepts of formal languages of finite automata techniques
2. To Design Finite Automata's for different Regular Expressions and Languages
3. To Construct context free grammar for various languages
4. To solve various problems of applying normal form techniques, push down automata and Turing Machines
5. To participate in GATE, PGECET and other competitive examinations

UNIT – I: FINITE AUTOMATA (FA): (6 Hours)

Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines).

UNIT - II REGULAR EXPRESSIONS (RE): (6 Hours)

Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA.

UNIT – III: CONTEXT FREE GRAMMER (CFG): (6 Hours)

Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF.

UNIT – IV PUSHDOWN AUTOMATA: (6 Hours)

Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA

UNIT – V: TURING MACHINES (TM): (6 Hours)

Formal definition and behaviour, Languages of a TM, TM as accepters, and TM as a computer of integer functions, Types of TMs.

UNIT VI: RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES: (6 Hours)

Properties of recursive and recursively enumerable languages, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy.

Textbooks:

1. Introduction to Automata Theory, Languages, and Computation John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman. Pearson Publication.

Reference Books:

1. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou.
2. Automata and Computability, Dexter C. Kozen.
3. Introduction to the Theory of Computation, Michael Sipser.
4. Introduction to Languages and the Theory of Computation, John Martin.
5. Computers and Intractability: A Guide to the Theory of NP Completeness, M. R. Garey and D. S. Johnson.

(Sub. Code)	Operating System	4L: 2P: 0T	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**03 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**03**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

Course Pre-Requisites:
Prerequisites for this course include thorough knowledge in some high-level programming language as C or C++ and UNIX / Linux operating system environment. As programs are to be implemented by writing C code during the course and will cover the details of C and its close relationship to UNIX and Linux in the case study in 6th unit.

Course Objectives:
1. To learn the basic concepts of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication.
3. To learn the methods of process scheduling.
4. To gain knowledge on Mutual exclusion, deadlock detection algorithms.
5. To know the concept of memory management and virtual memory.
6. To learn programmatically file management techniques.

Course Outcomes:
1. To learn and apply the basic concept of operating system.
2. To infer the concept of process and process state transition and concept of thread and multithreading.
3. Understand the importance of scheduling and types of scheduling algorithms.
4. To gain the knowledge of inter process communication strategies, concept of deadlock along with its avoidance.
5. To analyse the memory management techniques, paging and segmentation.
6. To understand the file management and disk management techniques.

UNIT – I (8 Hours):

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

UNIT – II (8 Hours):

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.
Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

UNIT – III (8 Hours)

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR;
Multiprocessor scheduling: Real Time scheduling: RM and EDF.

UNIT – IV (8Hours)

Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.
Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery.

UNIT – V (8 Hours)

Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction.
Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

UNIT- VI (8 Hours):

I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.
Case study: UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls.

List of Assignments:
1. To learn evolution and structure of operating system.
2. To understand the concept of Real Time scheduling.
3. To analyse the problem of process synchronization.
4. To implement the shell programming in UNIX OS.

List of Laboratory Exercises:

1. Unix commands (files directory, data manipulation, network communication etc), shell programming and vi editor
2. C program implementation of the following:

a. Scheduling Algorithms
b. Shared memory
c. Thread and Multi Thread
d. Inter Process Communication
e. Deadlock Avoidance and Deadlock Detection
f. Semaphore
g. Memory Management
h. Indexing and Hashing

List of Project Based Learning Topics:

1. Virtual traffic management system using threads with semaphore to control traffic.
2. Virtual memory management system.
3. File system handling.
4. A Client -Server application, use of IPC.
5. A simple web browser.
6. Device driver for some device.
7. Design of mail system project.
8. Design of RTOS for embedded system.
9. Mini project on Linux Shell.
10. Railway reservation system using scheduling.

Textbooks:

1. Operating System Concepts Essentials. Abraham Silber Schatz, Peter Baer Galvin and Greg Gagne.

Reference Books:

1. Operating Systems: Internals and Design Principles. William Stallings.
2. Operating System: A Design-oriented Approach. Charles Patrick Crowley.
3. Operating Systems: A Modern Perspective. Gary J. Nutt.
4. Design of the Unix Operating Systems. Maurice J. Bach.
5. Understanding the Linux Kernel, Daniel Pierre Bovet, *iraseC, ocraM*

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

(Sub. Code)	Algorithms Analysis and Design	4L:2P:0T	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes:

At the end of the course learner will be able to

7. Interpret the performance of algorithms using analysis techniques.
8. Describe, apply and analyze the complexity of Divide and Conquer strategies.
9. Describe, apply and analyze the complexity of Greedy Methods.
10. Describe, apply and analyze the complexity of Dynamic Programming Approach.
11. Implement graphs and tree algorithms and String-Matching Algorithms.
12. Summarize the advanced types of algorithms and Complexity class.

Unit 1: Introduction (8 hours):

Performance analysis, space, and time complexity Growth of function, Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour.
Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

Unit 2: Divide and Conquer Approach: (8 hours)

General method, Merge sort, Quick sort, Finding minimum and maximum algorithms and their Analysis, Binary search and Analysis, Strassen's Matrix multiplication.

Unit 3: Greedy Method Approach: (8 hours)

General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees: Kruskal and Prim's algorithms**,** Ford-Fulkerson algorithm, Huffman Coding.

Unit 4: Dynamic Programming Approach: (8 hours)

General Method, Multistage graphs, all pair shortest path: Floyd Warshall Algorithm, Network Flow Algorithm, Assembly-line scheduling Problem, 0/1 knapsack Problem, Travelling Salesperson problem, longest common subsequence.

Unit 5: Graph Theory and String-Matching Algorithms: (8 hours)

Graph and Tree Algorithms: Self-Balancing tree, B Trees, B+ Trees, Single source shortest path: Bellman Ford Algorithm.
String Matching Algorithms: The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm.

Unit 6: Advance Strategies: (6 hours)

Approximation algorithms, Randomized algorithms, Introduction to Quantum Algorithms and parallel algorithms. Complexity class: Definition of P, NP, NP-Hard, NP-Complete.

Text Books:

1. “Fundamentals of Computer Algorithms”, E. Horowitz and S. Sahni, Orient Black.
2. “Introduction to Algorithms”, T. H. Cormen, C. E. Leiserson and R. L. Rivest,PHI Learning Pvt. Ltd. (Originally MIT Press).
3. “The Design and Analysis of Computer Algorithms”, A. Aho, J. Hopcroft and J. Ullman, Pearson Education India.
4. Computer Algorithms: Introduction to Design and Analysis, S. Baase, Pearson Education India.
5. “The Art of Computer Programming”, D. E. Knuth, Addison Wesley.

Reference Book:

1. M. Welss, “Data Structures and Algorithm Analysis in C++", Pearson Education, ISBN-81-7808-670-0.
2. G. A.V, PAI, “Data Structures and Algorithms “, McGraw Hill, ISBN -13: 978-0-07-066726-6.

Theory Subject Assignments:

Each assignment should have 3 questions.

Lab Experiments list:

1. Discuss the different types of sorting techniques.
2. Write and analyze code to sort an array of integers using merge sort.
3. Write and analyze to sort an array of integers using divide and conquer quick sort Method.
4. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
5. Write a program to Implement 0/1 Knapsack problem using Dynamic Programming.
6. Write a program to implement the Longest Common Subsequence problem using Dynamic Programming.
7. Write a program to Implement N Queens problem using Backtracking.
8. Write a Code to find the shortest path using Bellman-Ford algorithm.
9. Write a program to implement quick sort using randomized algorithm.
10. Write a program to implement a network flow algorithm.

Subject Assignments (Project Topics):

1. Design and develop a project for Search engine using data structures.
2. Design and develop a project for Google form like application.
3. Design and develop a project for shortest path calculation for travelling salesman Problem.
4. Design and develop a project for finding keywords from the paragraph.
5. Design and develop a project for Customer Billing system.
6. Design and develop a project for word dictionary using search tree concept.
7. Design and develop a project for salary calculation of employees based on performance.
8. Design and develop a project for password recovery system
9. Create a mini project to construct a game: Create Sudoku.

Data Warehousing and Mining

(Sub. Code)	Data Warehousing and Mining (Subject Name)	4L:0T:0P	04 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
		Internal Assessment	**40 Marks**		
		Total	**100 Marks**	**Total**	**04**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the concepts of data warehouse, their data model, data cube and Data warehouse design principles and implementation.
2. Student will have the basic understanding about data mining, preprocessing, supervised and unsupervised learning.
3. Student will apply the knowledge of Data mining and warehousing methods in fraud detection and AI.

Unit 1: Introduction to Data Warehouse (6 hours):

Basic concepts, What Is a Data Warehouse? Differences between Operational Database Systems and Data Warehouses, Comparison of OLTP and OLAP Systems, A Multitiered Architecture, Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse, ETL operations.

Unit 2: Data Warehouse Data Modeling (6 hours):

Data Cube: A Multidimensional Data Model, Data Cube Computation: Preliminary Concepts, Cube Materialization, General Strategies for Data Cube Computation, Overview of Data Cube Computation Methods, Schemas for Multidimensional Data Models, Concept hierarchies, OLAP operations, OLAP Systems versus Statistical Databases.

Unit 3: Data Warehouse Design, Usage, and Implementation (6 hours):

A Business Analysis Framework for Data Warehouse Design, Data Warehouse Design Process, Data Warehouse Usage for Information Processing, From Online Analytical Processing to Multidimensional Data Mining, Efficient Data Cube Computation: An Overview, Partial Materialization: Selected Computation of Cuboids, Indexing OLAP Data: Bitmap Index and Join Index, Efficient Processing of OLAP Queries, OLAP Server Architectures: ROLAP versus MOLAP versus HOLAP.

Unit 4: Introduction to Data Mining (6 hours):

What Is Data Mining? Data Mining and Related Terms, Knowledge based System, KDD Process Model, CRISP - DM, Terminology and Notation, targeted Applications, Issues in Data Mining, Data

Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Preparation, Data Cleaning, data reduction Missing data, Coding Systems, Discretization.

Unit 5: Association Mining, Classification and Regression Analysis (6 hours):

Association: Frequent itemset, Frequent Itemset Mining Methods: A priori Algorithm, Improving the Efficiency of A priori, A Pattern-Growth Approach for Mining Frequent Item sets, Discovering Association Rules in Transaction, Databases, Generating Candidate Rules, Selecting Strong Rules.

Classification: Introduction, Supervised and Unsupervised, Decision Tree Induction, Naïve Bayesian Classification, Rule based classification.

Regression Analysis: Simple linear regression, Logistic Regression: Model with a Single Predictor, Estimating the Logistic Model from Data, Interpreting Results in Terms of Odds, Evaluating Classification Performance, Variable Selection, Data Preprocessing, Model Interpretation.

Unit 6: Cluster Analysis and Outlier Analysis (6 Hours):

Cluster Analysis: Introduction, Measuring Distance Between Two Records, Measuring Distance Between Two Clusters, Hierarchical (Agglomerative) Clustering, k-Means Algorithm, Partitioned Methods, Hierarchal Methods, Density and Grid Based Methods.

Outlier Detection: Outliers and Outlier Analysis, Outlier Detection Methods, Statistical Approaches, Proximity-Based Approaches, Clustering-Based Approaches, Classification-Based Approaches, Mining Contextual and Collective Outliers, Outlier Detection in High-Dimensional Data.

Home Assignments:

Course faculty must design one home assignment of every unit.

Text Books:

1. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan Kaufmann Publisher, 3rd Ed, 2010.
2. Ralph Kimball and Margy Ross,” The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling”, Wiley Publisher, 3rd Edition.
3. Charu C Agarwal, “Data Mining: The Textbook”, Springer, 2015

Syllabus for Unit Test:	
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

(Sub. Code)	Foundations of Artificial Intelligence	4L:0T:2P	5 credits

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Theory:	**04 Hours/Week**	**End Semester Examination**	**60 Marks**	**Theory**	**04**
Practical:	**02 Hours/Week**	**Internal Assessment**	**40 Marks**		
		Term work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Pre-Requisites: Discrete mathematics, Data structures, Algorithms Analysis and Design.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Describe the concept of Artificial Intelligence, Intelligent agents and Learning agents.
2. Identify issues in problem solving and apply the appropriate search methods.
3. Use the appropriate search method and identify the constraints.
4. Describe and select the different knowledge representation methods.
5. Identify the components of planning for a particular System.
6. Use appropriate domain knowledge and develop an Expert system.

Unit 1: Introduction to Artificial Intelligence (6 hours):
Introduction: Introduction to AI, Problems of AI, AI Techniques, Problem Formulation, Tic-Tac-Toe problem. Intelligent Agents: Structure of Intelligent Agents, Types of Agents, Agent Environments PEAS Representation for an Agent.

Unit 2: Search Techniques (10 hours):
Problem Solving, Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.
Search techniques: 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 3: Constraint satisfaction problems (6 hours):
Local search for constraints Satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

Unit 4: Knowledge & Reasoning (6 hours):
Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, Properties of WFF, representing instant & ISA relationship, computable functions & predicates, resolution, natural

deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

Unit 5: Probabilistic Reasoning (6 hours):
Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

Unit 6: Expert Systems (6 hours):
Rule based systems, Nonproduction systems: decision tree architectures, blackboard system architectures, neural network architectures.
Learning: Types of learning, general learning model, Learning by induction: generalization, specialization; example of inductive learner.

Text/Refence Books

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson.
2. E. Rich, K. Knight and S. Nair, Artificial Intelligence, McGraw Hill.
3. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education.

Reference Book:

1. Artificial Intelligence, Ritch & Knight, TMH.
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI.
3. Logic & Prolog Programming, Saroj Kaushik, New Age International.
4. Expert Systems, Giarranto, VIKAS.
5. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
6. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press; 2 edition, 2004.
7. Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.

NPTEL Course:
Link:

https://nptel.ac.in/courses/106105079/

https://nptel.ac.in/courses/106106142/

https://nptel.ac.in/courses/111107058/

https://nptel.ac.in/courses/111106086/

Theory Subject Assignments:

(Unit wise minimum 3 questions.)

Lab Assignment:

(Minimum 10 lab assignments)

(Sub. Code)	Computational Lab-I (Subject Name)	0L:0T:2P	1 credit

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Practical:	**02 Hours/Week**	**Term work**	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**01**

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. To understand the predefined libraries in python.
2. To explore the data wrangling technique with python
3. To explore the data aggregation and group operation in functions in python.
4. To develop program for time series using built in functions in python.
5. To understand the data visualization and web scrapping concepts using python.

Unit 1: NumPy and Pandas (6 hours):

Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, creating array views copies, manipulating array shapes I/O Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames

Unit 2: Data Wrangling (6 hours):

Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions

Unit 3: Data Aggregation, Group Operations (6 hours):

Group By Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations

Unit 4: Time series (6 hours):

Time Series Basics, Data Ranges, Frequencies and Shifting.

Unit 5: Data Visualization (6 hours):

Data visualization using python matplotllib and seaborn library, also introduction tableau.

Unit 6: Web Scrapping (6 hours):

Introduction to web scrapping, libraries for web scrapping, Component for web scrapping.

Text/Refence Books

1. Programming Python, Mark Lutz.
2. Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.
3. Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005.

Lab Assignment:

1. Implementation of basic data structures in Python.
2. File Handling in the Python.
3. Introduction to data set handling in Python.
4. Implementation of Date and time function using python.
5. Implement of python predefined library functions Panda and NumPy,
6. Implementation of data wrangling, data aggregation, group operations and time series operations.
7. Implementation of time series analysis using python.
8. Data Visualization in python (seaborn library).
9. Web scrapping in python (beautiful soup)
10. Introduction text preprocessing of data.
11. Mini project.

(Minimum 10 lab assignments)

Machine Learning

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	04 Hours/Week	University Examination:	60 Marks		
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Lecture	04
		Term Work	25 Marks	Practical	01
		Practical	25 Marks		
		Total	150 Marks	Total	05

Prerequisite: Basic Probability and Statistics, Data Structures, Algorithms.

Course Objectives:

1. To introduce the basic concepts and techniques of Machine Learning.
2. To acquire in depth understanding of various supervised and unsupervised algorithms.
3. To be able to apply various ensemble techniques for combining ML models.
4. To demonstrate dimensionality reduction techniques.

Course Outcomes: At the end of this course, students will demonstrate the ability to (**COs**):

1. To acquire fundamental knowledge of developing machine learning models.
2. To select, apply and evaluate an appropriate machine learning model for the given.
3. To demonstrate ensemble techniques to combine predictions from different models.
4. To demonstrate the dimensionality reduction techniques.
5. Design application using machine learning techniques using languages such as Python.

Unit I - Introduction to Machine Learning	**06 Hours**
Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application. Training Error, Generalization error, Overfitting, Underfitting, Bias Variance trade-off.	
Unit II - Learning with Regression and Trees	**08 Hours**
Learning with Regression: Linear Regression, Multivariate Linear Regression, Logistic Regression. Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index (Regression), Classification and Regression Trees (CART). Performance Metrics: Confusion Matrix, [Kappa Statistics], Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve.	
Unit III - Ensemble Learning	**04 Hours**
Understanding Ensembles, K-fold cross validation, Boosting, Stumping, XGBoost. Bagging, Subagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers.	
Unit IV - Learning with Classification	**08 Hours**

Support Vector Machine Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, Quadratic Programming, SVM for linear and nonlinear classification, Basics of Kernel trick. Support Vector Regression, Multiclass Classification. k-Nearest Neighbour Classification, Bayesian concept learning, Naive Bayes classifiers.	
Unit V - Learning with Clustering	**08 Hours**
Introduction to clustering with overview of distance metrics and major clustering approaches. Graph Based Clustering: Clustering with minimal spanning tree Model based Clustering: Expectation Maximization Algorithm, Density Based Clustering: DBSCAN.	
Unit VI – Dimensionality Reduction	**04 Hours**
Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Valued Decomposition.	

Textbooks

1. Tom M. Mitchell, ―Machine Learning‖ McGraw Hill.
2. Stephen Marsland, ―Machine Learning An Algorithmic Perspective‖, CRC Press.
3. Peter Harrington, ―Machine Learning n Action‖, Dream Tech Press.

Reference Books

1. Samir Roy and Chakraborty, ―Introduction to soft computing‖, Pearson Edition.
2. Richard Duda, Peter Hart, David G. Stork, ―Pattern Classification‖, Second Edition, Wiley Publications

List of Assignments

(Unit wise minimum 3 questions.)

List of Internal Assignment will be framed by respective Course Coordinator.

Lab Experiment (Pre-Processing & Build the Library):

1. To implement Linear Regression.
2. To implement Logistic Regression.
3. To implement SVM.
4. To implement PCA.
5. To implement Steepest Descent.
6. To implement Random search.
7. To implement Naïve Baysian algorithm.
8. To implement Single layer Perceptron Learning algorithm.
9. To implement Radial basis functions.
10. Case study based on any ML technique.

Project Based Learning:	
List of Project will be framed by respective Course Coordinator.	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI
Useful Digital Links:	
1. Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets	
2. https://onlinecourses.nptel.ac.in/noc21_cs85/preview	
3. Machine Learning from Coursera.	
4. https://towardsdatascience.com/machine-learning/home	

Software Engineering

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Pre-requisites: The students should have knowledge of

1. Programming Skill
2. Data structure

Course Objective:

To learn and understand the Concepts of Software Engineering

- To Learn and understand Software Development Life Cycle
- To apply the project management and analysis principles to software project development.
- To apply the design & testing principles to software project development

Course Outcomes: The student will be able to

1. Learn importance of software engineering process and ilS principles
2. Understand the software development life cycle with appropriate models
3. Understand software quality concepts
4. Document user requirements using suitable techniques
5. Analyze the software design from and Object-Oriented perspective.
6. Apply appropriate testing techniques on a software and understand the new trends in software Engineering.

Unit I Introduction Software	**08 Hours**
Introduction Software What is software? Types of software Characteristics of Software Attributes of good software Software Engineering What is software engineering? Software engineering costs What are the key challenges facing software engineering? Systems engineering & software Engineering.	
Unit II -Software Development Process Models	**08 Hours**
What is a software process? What is a software process model? The waterfall model Evolutionary development Component-Based Software Engineering (CBSE) Process Iteration Incremental Delivery Spiral Development Rapid software development Agile methods Extreme programming Rapid application development (RAD) Software prototyping Computer Aided Software Engineering (CASE) Overview of CASE approach Classification of CASE tools.	
Unit III - Software Requirement Analysis and Specification	**08 Hours**

System and software requirements Types of software requirements Functional and non-functional requirements Domain requirements User requirements Elicitation and analysis of requirements Overview of techniques Viewpoints Interviewing Scenarios Use-cases Process modelling with physical and logical DFDs Entity Relationship Diagram Data Dictionary Requirement Validation Requirement Specification Software Requirement Specification (SRS) Structure and contents SRS format Feasibility.	
Unit IV - Software Design**:**	**08 Hours**
Design concepts Abstraction Architecture Patterns Modularity Cohesion Coupling Information hiding Functional independence Refinement Design of input and Control Design of User Interface design Elements of good design Design issues Features of modern GUI - Menus, Scroll bars, windows, Buttons, icons, panels, error Messages etc.	
Unit V - Software Testing and Quality Assurance	**06 Hours**
Verification and validation Techniques of testing Black-box and White-box testing Inspections Levels of testing Unit testing Integration Testing Interface testing System testing Alpha and beta testing Regression testing Design of test cases Quality management activities Product and process quality Standards ISO9000 Capability Maturity Model (CMM)	
Unit VI – Current trends in Software Engineering	**04 Hours**
Software Engineering for projects and products. Introduction to Web Engineering and Agile process	

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Reference Books:

1. Lisa Crispin, Janet Gregory, “Agile Testing: A Practical Guide for Testers and Agile Teams”, International edition, Addison Wesley.
2. Software Engineering: A practitioner's approach by Roger S. Pressman, 7th edition, McGraw-Hill International edition.
3. Software Engineering by Ian Sommerville, 7th edition, Addison-Wesley.
4. Fundamentals of Software Engineering by Rajib Mall.

Lab Exercise:

1. Preparing Software Requirements Specifications
2. Identifying Domain Classes from the Problem Statements
3. Modeling UML Class Diagrams and Sequence diagrams
4. Modeling UML Use Case Diagrams and Capturing Use Case Scenarios
5. E-R Modeling

6. State chart and Activity Modeling
7. Modeling Data Flow Diagrams
8. Estimation of Project Metrics
9. Estimation of Test Coverage Metrics and Structural Complexity
10. Designing Test Suites
11. Preparing Final Project Report

Internet of Things					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**25 Marks**	**Practical**	**01**
		Oral	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Objectives:
1. To understand Internet of Things (IoT) and types of sensors.
2. To comprehend Characteristics and Conceptual Framework of IoT
3. To understand levels of the IoT architectures
4. To correlate the connection of smart objects and IoT access technologies
5. To Interpret edge to cloud protocols
6. To explore data analytics and data visualization on IoT Data
7. To explore IoT applications
Course Outcomes: Learner will be able to
1. Describe the Characteristics and Conceptual Framework of IoT
2. Differentiate between the levels of the IoT architectures
3. Analyze the IoT access technologies
4. Illustrate various edge to cloud protocol for IoT
5. Apply IoT analytics and data visualization
6. Analyze and evaluate IoT applications
Prerequisite: Python programming, C programing language, Computer Networks

Sr. No.	Module	Detailed Content	Hours
1	Introduction to IoT	Introduction to IoT- Defining IoT, Characteristics of IoT, Conceptual Framework of IoT, Functional blocks of IoT, Brief review of applications of IoT. Smart Object – Definition, Characteristics and Trends. Introduction the Sensors and actuators. Self-learning Topics: Hardware and software development tools for - Arduino, Node MCU, ESP32, Raspberry Pi.	6 Hrs
2	Architecture	Recap of OSI 7-layer architecture and mapping to loT architecture, loT reference architectures, Industrial Internet Reference Architecture, loT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing. IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud Self-	8 Hrs

		learning Topics: Brief review of applications of IoT: Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures etc.	
3	**Networking for loT** - Principles of Connected Devices and Protocols	RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE) roles, LiFi, WPAN std: 802.15 standards: Bluetooth, IEEE 802.15.4, Zigbee, Z-wave, Narrow Band IoT, Internet Protocol and Transmission Control Protocol, 6LoWPAN, WLAN and WAN, IEEE 802.11, Long-range Communication Systems and Protocols: Cellular Connectivity LTE, LTE-A, LoRa and LoRaWAN.	8 Hrs
4	Edge to Cloud Protocol	HTTP, WebSocket, Platforms. HTTP - MQTT - Complex Flows: IoT Patterns: Real-time Clients, MQTT, MQTT-SN, Constrained Application Protocol (CoAP), Streaming Text Oriented Message Protocol (STOMP), Advanced Message Queuing Protocol (AMQP), Comparison of Protocols.	6 Hrs
5	IoT and Data Analytics	Defining IoT Analytics, IoT Analytics challenges, IoT analytics for the cloud, Data organizing Strategies for IoT Analytics, Linked Analytics Data Sets, Managing Data lakes, The data retention strategy, visualization and Dashboarding-Designing visual analysis for IoT data, creating a dashboard, creating, and visualizing alerts.	6 Hrs
6	IoT Application Design	Prototyping for IoT, Case study related to: Home Automation, Smart Cities, Environment, Agriculture, Smart Library. Introduction to IIoT, Use cases of the IIoT, IoT and IIoT – similarities and differences, Introduction to Internet of Behavior (IoB) Self-learning Topics: Internet of Behaviors (IoB) and its role in customer services. Case Study 1-3.	8 Hrs

Hands on Project:
List of Project will be framed by respective Course Coordinator.

Text Book
1. Arsheep Bahga (Author), Vijay Madisetti, Internet of Things: A Hands-On Approach Paperback, Universities Press, Reprint 2020
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals Networking Technologies, Protocols, and Use Cases for the Internet of Things CISCO.
3. Analytics for the Internet of Things (IoT) Intelligent Analytics for Your Intelligent Devices. Andrew Minteer, Packet
4. Giacomo Veneri, Antonio Capasso, ‖ Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0‖, Packt.

References:
1. Pethuru Raj, Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases by, CRC press,
2. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw Hill Education, Reprint 2018.
3. Perry Lea, Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publications, Reprint 2018.
4. Amita Kapoor, ―Hands on Artificial intelligence for IoT‖, 1st Edition, Packt Publishing, 2019.
5. Sheng-Lung Peng, Souvik Pal, Lianfen Huang Editors: Principles of Internet of Things (IoT)Eco system:Insight Paradigm, Springer

Online References:
1. https://owasp.org/www-project-internet-of-things/
2. NPTEL: Sudip Misra, IIT Khargpur, Introduction to IoT: Part-1, https://nptel.ac.in/courses/106/105/106105166/
3. NPTEL: Prof. Prabhakar, IISc Bangalore, Design for Internet of Things, https://onlinecourses.nptel.ac.in/noc21_ee85/preview
4. Mohd Javaid, Abid Haleem, Ravi Pratap Singh, Shanay Rab, Rajiv Suman, Internet of Behaviours (IoB) and its role in customer services, Sensors International, Volume 2,2021,100122, ISSN 2666-3511,https://doi.org/10.1016/j.sintl.2021.100122

Syllabus for Unit Tests:
Unit Test -1 Unit – I, Unit – II, Unit - III
Unit Test -2 Unit – IV, Unit – V, Unit - VI

Big Data Analysis

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	04 Hours/Week	University Examination:	60 Marks		
Practical:	---	Internal Assessment:	40 Marks	Lecture	04
		Term Work	---	Practical	00
		Oral	---		
		Total	100 Marks	Total	04

Course Outcomes: At the end of this course, students will demonstrate the ability to:

6. Understand how to leverage the insights from big data analytics
7. Analyze data by utilizing various statistical and data mining approaches
8. Perform analytics on real-time streaming data
9. Understand the various NoSql alternative database models
10. Understand the Stream Data Model and Real Time Sentiment Analysis.
11. Understand the pig Data Model and Aggregated data model.

Unit I: INTRODUCTION TO BIG DATA	**08 Hours**
Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.	
Unit II HADOOP FRAMEWORK	**08 Hours**
Basic of Data Warehousing, Disadvantage of data warehousing, Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix- Vector Multiplication – Hadoop YARN.	
Unit III DATA ANALYSIS	**08 Hours**
Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.	
Unit IV MINING DATA STREAMS	**08 Hours**
Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.	
Unit V CLUSTERING AND CLASSIFICATION	**08 Hours**
Advanced Analytical Theory and Methods: Overview of Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Reasons to Choose and Cautions. Classification: Decision Trees – Overview of a Decision Tree – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes Bayes‘Theorem – Naïve Bayes Classifier.	

Unit VI BIG DATA FRAMEWORKS	**08 Hours**
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Typesand File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.	

Textbooks

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

Reference Books

1. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.

List of Assignments:

1. List the main characteristics of big data architecture with a neat schematic diagram.
2. Explain in detail about the challenges of conventional system.
3. How would you show your understanding of the tools, trends, and technology in big data
4. What are the best practices in Big Data analytics? Explain the techniques used in Big Data Analytics.
5. Discuss the following features of Apache Hadoop in detail with diagram as necessary.
6. Describe briefly about Hadoop input and output and write a note on data integrity.
7. Explain clustering and classifications in detail.

Project Based Learning:

1. Market Basket Analysis
2. Airline Dataset Analysis
3. Data Analysis using Clustering

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Compiler Construction

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**---**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**---**	**Practical**	**---**
		Oral	**---**		
		Total	**100 Marks**	**Total**	**04**

Course Outcomes: At the end of this course, students will demonstrate the ability to:

1. Demonstrate the functioning of a Compiler and to develop a firm and enlightened grasp of concepts such as higher-level programming, assemblers, automata theory, and formal languages, language specifications.
2. Develop language specifications using context free grammars (CFG).
3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems.
4. Constructing symbol tables and generating intermediate code.
5. Obtain insights on compiler optimization.
6. Apply the skills on devising, selecting, and using tools and techniques towards compiler design.

Unit I – Introduction to Compiler and Lexical analysis	**08 Hours**
Introduction to programming language translators-Structure and Phases of a Compiler-DesignIssues-Patterns-Lexemes-Tokens-Attributes-Specification of Tokens-Extended Regular Expression- Regular expression to Deterministic Finite Automata (Direct method).	
Unit II – Syntax Analysis	**08 Hours**
Role of Parser- Parse Tree - Elimination of Ambiguity - Top-Down Parsing - Recursive Descent Parsing – Non-Recursive Descent Parsing - Predictive Parsing – LL (1) Grammars. Shift Reduce Parsers- Operator Precedence Parsing -LR Parsers, Construction of SLR Parser Tables and Parsing, CLR Parsing, LALR Parsing.	
Unit III – Semantic Analysis	**08 Hours**
Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation-Syntax Directed Translation Schemes - Implementation of L attributed Syntax Directed Definition.	
Unit IV – Intermediate Code Generation	**08 Hours**
Variants of Syntax trees - Three Address Code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching-Switch Case Statements.	
Unit V – Code Optimization	**08 Hours**
Loop optimizations- Principal Sources of Optimization -Introduction to Data Flow Analysis-Basic Blocks - Optimization of Basic Blocks - Peephole Optimization- The DAG Representation of Basic Blocks -Loops in Flow Graphs.	
Unit VI – Code Generation	**08 Hours**

Issues in the design of a code generator- Target Machine- Next-Use Information - Register Allocation and Assignment, Runtime Organization, Activation Records. Current Trends.	
Textbooks:	
1. A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, techniques, &tools, Second Edition, Pearson Education, 2007.	
2. K. D. Cooper and L. Torczon, Engineering a compiler, Morgan Kaufmann, 2nd edition, 2011.	
3. Steven S.Muchnick "Advanced Compiler design implementation", Elsevier Science India, 2003.	
Reference Books	
1. Andrew A.Appel , Modern Compiler Implementation in Java, Cambridge University Press; 2ndedition, 2002.	
2. Allen Holub, Compiler Design in C, Prentice Hall, 1990	
3. Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.	
List of Assignments	
(Unit wise minimum 3 questions.) **List of Internal Assignment will be framed by respective Course Coordinator.**	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Computing Lab -II (Adv. Python)

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**00 Hours/Week**	**University Examination:**	**-**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**-**	**Lecture**	**00**
		Term Work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**50 Marks**	**Total**	**01**

Course Objective:

To develop analytical skills among the students using data analysis methods and Python.

Prerequisite:

The students should have knowledge of basics of statistics and python programming.

Course Outcomes: On completion of the course, students will have the ability to:

1. To understand the predefined libraries in python.
2. To explore the data wrangling technique with python
3. To explore the data aggregation and group operation in functions in python.
4. To develop program for time series using built in functions in python.
5. To understand the data visualization and web scrapping concepts using python.

Unit I: NumPy and Pandas	**06 Hours**
Creating NumPy arrays, Indexing and slicing in NumPy, creating multidimensional arrays, NumPy Data types, Array Attribute, Indexing and Slicing, creating array views copies, manipulating array shapes I/O Basics of Pandas, Using multilevel series, Series and Data Frames, Grouping, aggregating, Merge Data Frames.	
Unit II: Data Wrangling:	**06 Hours**
Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions.	
Unit III: Data Aggregation, Group Operations	**06 Hours**
Group By Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations.	
Unit IV: Time series	**06 Hours**
Time Series Basics, Data Ranges, Frequencies and Shifting.	
Unit V: Data Visualization	
Data visualization using python matplotllib and seaborn library, also introduction tableau.	**06 Hours**
Unit VI: Web Scrapping:	**06 Hours**
Introduction to web scrapping, libraries for web scrapping, Component for web scrapping.	

Textbooks

1. Programming Python, Mark Lutz.
2. Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.

3. Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005.

Reference Books

1. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data"O'Reilly Media.

List of Laboratory Exercises

1. Implementation of basic data structures in Python.
2. File Handling in the Python.
3. Introduction to data set handling in Python.
4. Implementation of Date and time function using python.
5. Implement of python predefined library functions Panda and NumPy,
6. Implementation of data wrangling, data aggregation, group operations and time series operations.
7. Implementation of time series analysis using python.
8. Data Visualization in python (seaborn library).
9. Web scrapping in python (beautiful soup)
10. Introduction text preprocessing of data.

Project Based Learning:

Mini Project based on the content of the syllabus (Group of 2-3 students).

Deep Learning

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	04 Hours/Week	University Examination:	60 Marks		
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Lecture	04
		Term Work	25 Marks	Practical	01
		Practical	25 Marks		
		Total	150 Marks	Total	05

Prerequisite: Basic Probability and Statistics, Data Structures, Algorithms, Machine Learning.

Course Objectives:

1. To introduce the basic concepts and techniques of Deep Learning.
2. To acquire in depth understanding of various supervised and unsupervised algorithms.
3. To be able to apply various ensemble techniques for combining ML models.
4. To demonstrate dimensionality reduction techniques.

Course Outcomes: At the end of this course, students will demonstrate the ability to (**COs**):

1. Have a good understanding of the fundamental issues and basics of machine learning.
2. Ability to differentiate the concept of machine learning with deep learning techniques.
3. Understand the concept of CNN and transfer learning techniques, to apply it in the classification problems.
4. Learned to use RNN for language modelling and time series prediction.
5. Use autoencoder and deep generative models to solve problems with high dimensional data including text, image and speech.
6. Design and implement various machine learning algorithms in a range of real-world applications.

Unit I - Machine Learning Basics	**04 Hours**
Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality.	
Unit II - Introduction to Deep Learning & Architectures	**08 Hours**
Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders.	
Unit III - Convolutional Neural Networks	**04 Hours**
Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.	
Unit IV - Transfer Learning	**08 Hours**
Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.	
Unit V - Sequence Modelling – Recurrent and Recursive Nets	**08 Hours**

Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks.	
Unit VI – Auto Encoders, Deep Generative Models & Recent Trends	**08 Hours**
Under complete Autoencoders – Regulraized Autoencoders – stochastic Encoders and Decoders – Contractive Encoders. Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine - Generative Adversarial Networks. Recent Deep learning trends- Like: GRU.	

Textbooks

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" A press, 2018.
3. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.

Reference Books

1. Samir Roy and Chakraborty, ―Introduction to soft computing‖, Pearson Edition.
2. Richard Duda, Peter Hart, David G. Stork, ―Pattern Classification‖, Second Edition, Wiley Publications

List of Assignments

(Unit wise minimum 3 questions.)

List of Internal Assignment will be framed by respective Course Coordinator.

Lab Experiment:

1. Classification with Multilayer Perceptron using Scikit-learn (MNIST Dataset).
2. Deep learning Packages Basics: Tensorflow, Keras, Theano and PyTorch.
3. Classification of MNIST Dataset using CNN.
4. Face recognition using CNN.
5. Sentiment Analysis using CNN.
6. Dimensionality Reduction using Deep learning.
7. Language Modeling using RNN.
8. Time Series Prediction using RNN.
9. Sentiment Analysis using LSTM.
10. Image generation using GAN.

Project Based Learning: Group of students.

List of Project will be framed by respective Course Coordinator.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Useful Digital Links:
1. Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2. https://onlinecourses.nptel.ac.in/noc21_cs85/preview
3. Machine Learning from Coursera.
4. https://towardsdatascience.com/machine-learning/home

Computer Networks

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**25 Marks**	**Practical**	**01**
		Oral	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Outcomes: At the end of this course, students will demonstrate the ability to:

1. Demonstrate the concepts of data communication at physical layer and compare ISO - OSI model with TCP/IP model.
2. Explore different design issues at data link layer.
3. Design the network using IP addressing and sub netting / super netting schemes.
4. Analyse transport layer protocols and congestion control algorithms. 5 Explore protocols at application layer.

Unit I : Basics of Computer Networks	**06 Hours**
Introduction to computer network, Types of computer network,Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; Distributed and SDN, OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for Layers, Transmission Mediums: CAT5, 5e, 6, OFC and Radio Spectrum, Network Devices: Bridge, Switch, Router, Brouter and Access Point.	
Unit II: Data Link Layer	**06 Hours**
Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet. THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth	
Unit III: Network Layer	**06 Hours**
Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Routing Protocols: Distance Vector, Link State, Path Vector, Routing inInternet: RIP, OSPF, BGP.	
Unit IV: Transport Layer	**06 Hours**
Transport Service, transport layer protocols for flow control, Elements of Transport Protocols, Multiplexing, Congestion Control, Example protocols:UDP, TCP.	
Unit V: Application Layer	**06 Hours**
Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host ControlProtocol (DHCP), WWW, HTTP, SNMP, Bluetooth, Firewalls.	
Unit VI: Network Security	**06 Hours**
Network Security: Electronic mail, directory services and networkmanagement, Basic concepts of Cryptography.	

Textbooks

1. Fourauzan B.,"Data Communications and Networking", 5 th Edition, Tata McGraw- Hill, Publications, ISBN:0–07 – 058408 – 7
2. Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearson India, 2012.

Reference Books

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
3. Douglas E. Comer & M.S Narayanan,"Computer Network & Internet", Pearson Education

List of Assignments

1. Study of LAN environment.
2. Explain OSI Model in detail.
3. Explain error detection and correction methods with example.
4. Study the concept of subnetting at network layer.
5. Discuss switching techniques in detail.
6. Explain multiplexing methods in detail.
7. Assignment on Application Layer
8. Assignment on Bandwidth utilization techniques.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit – III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

List of Laboratory Exercises

1. Setup a wired LAN using Switch, Router and then IP switch of minimum four computers, configuration machine using IP addresses, testing using PING utility using Network Simulation tool Cisco Packet Tracer.
2. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes and CRC.
3. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer-to-peer mode.
4. Write a program to demonstrate subnetting and find the subnet masks.
5. Configure RIP/OSPF/BGP using packet Tracer.
6. Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa.
7. Write a program using TCP socket for wired network.
8. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.
9. Use network simulator NS2 to implement: Monitoring traffic for the given topology.
10. Study of Installation and configuration of DHCP server.

Robotics Process Automation					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**150 Marks**	**Total**	**05**

Course Objectives:
1. To introduce various types of Robots and the functional elements of Robotics
2. To impart knowledge of robot drive systems
3. To introduce various types the end effectors
4. To educate on various sensors used in Robotic automation
5. To introduce the basic mathematical modeling of a robot
6. To impart knowledge of basics of Robot Programming and robotic Applications
Course Outcomes: Learner will be able to
1. Understand Basic Concepts of Robotics Differentiate Between the Levels Of The Iot Architectures
2. Select Appropriate Drive for Robotic Applications.
3. To Compare and Select Robot and End Effectors As Per Application
4. To Select Proper Sensors for Robot as Per Application Requirement.
5. To Know About the Basic Mathematical Modelling of Robot.
6. To Know About the Fundamentals of Robot Programming and Applications.

Sr. No.	Module	Detailed Content	Hours
1	**Fundamentals of Robotics**	Historical development of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Asimov‘s laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot, Work cell control.	8 Hours
2	**Robot Drive Systems**	Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC-Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Power transmission systems for robot, Motion conversion, Determination of HP of motor, Types of Gearbox: - Planetary, Harmonic, Cycloidal gearbox and gear Ratio, variable speed arrangements.	8 Hours
3	**End Effectors**	Grippers, Mechanical Grippers, Pneumatic and Hydraulic-Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered	8 Hours

		and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations.	
4	**Robot Sensors**	Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Position sensors – Piezo Electric Sensor, LVDT, Resolvers, Encoders – Absolute and Incremental:- Optical, Magnetic, Capacitive, pneumatic, Position Sensors, Range Sensors- Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors, Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches, Machine vision.	8 Hours
5	**Mathematical Modeling of a robot**	General Mathematical Preliminaries on Vectors & Matrices, Link Equations and relationships, Direct Kinematics, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-ordinate System, inverse kinematics of two joints, DH Parameters, Jacobian Transformation in Robotic Manipulation.	8 Hours
6	**Fundamentals of Robot Programming and Applications**	Introduction to Robotic Programming, On-line and off-line programming, programming examples. Various Teaching Methods, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, various Textual Robot Languages, Typical Programming Examples such as Palletizing, Loading a Machine Etc. Robots in manufacturing and non- manufacturing applications, a robot-based manufacturing system, robot cell design considerations and selection of robot, Robot Economics, Functional Safety in Robotic Application.	8 Hours

Text Books:

1. Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta, Industrial Robotics, Technology, Programming & Applications, Tata McGraw Hill Education Pvt. Ltd. New Delhi.
2. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.
3. Groover M.P.-Automation, production systems and computer integrated manufacturing-Prentice Hall of India.

Reference Books:

1. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
2. Mikell P. Groover, Automation, Production Systems & Computer Integrated Manufacturing, PHI Learning Pvt. Ltd., New Delhi.
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson

Education, 2009
4. R K Mittal & I. J. Nagrath, Robotics and Control, McGraw Hill Publication, 2015.
5. Mike Wilson, Implementation of Robotic Systems, ISBN: 978-0-124-04733-4
6. www.roboanalyzer.com

E study material:

NPTEL Course on Robotics:
https://onlinecourses.nptel.ac.in/noc19_me74/preview
https://onlinecourses.nptel.ac.in/noc20_de11/preview

Guidelines for Laboratory Conduction

The student shall perform any 8 of the following:

1. Identify and selection of Sensors such as IR sensors, Proximity Sensor, Ultrasonic Sensor, White line sensor, Temperature Sensor, Touch sensor, Tilt Sensor, Accelerometer, Gyroscopic Sensor etc. based on given application.
2. Identify and selection of Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on application.
3. Demonstration of various robotic configurations using industrial robot.
4. Design and selection of Gripper / End effector.
5. One Programming exercise on lead through programming.
6. Use of Matlab/ Robo Analyser for direct and inverse kinematics of simple robot configuration.
7. One Industrial visit for Industrial robotic application.
8. Demonstration of simple robotic system using Matlab/ MscAdam / Robo Analyser software.
9. Choose the right robot for given manufacturing and non- manufacturing applications.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Quantitative Techniques, Communication and Values

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	04 Hours/Week	University Examination:	60 Marks		
		Internal Assessment:	40 Marks	Lecture	04
		Term Work	-	Practical	-
		Oral	-		
		Total	100 Marks	Total	04

Course Pre-requisites: The students should have knowledge of

1. Basic mathematics, reasoning and comprehensive ability
2. Communication process, soft skills
3. Leadership qualities, ethics, etiquettes and values

Course Objective:

The Quantitative Techniques, Communication and Values aims to augment students to face the campus recruitment test and train them on applying short techniques/ tricks to solve questions of Maths, reasoning and English in very less amount of time. The communication and values section focuses on the aspects of communication and soft skills such as grooming personality for leading team, presentation, business communication which would enable graduates to project themselves as a professional in the corporate sector and/or otherwise.

Course Outcomes: The student will be able to

1. Solve the aptitude test in the recruitment and competitive exam by applying short techniques and solve the question in less amount of time.
2. Apply the short mnemonics and techniques to solve the questions of logical reasoning in the placement and competitive exam in lesser time.
3. Develop the verbal ability to communicate effectively using suitable vocabulary and proper sentence pattern.
4. Understand the concept of soft skills and its implication at workplace.
5. Build up the ability to study employment business correspondences and its proper implications.
6. Understand business ethics, etiquettes and values and apply them in the professional ventures.

Unit I QUANTITATIVE APTITUDE	**08 Hours**
Number system, Percentage, profit and loss, Simple Interest and Compound Interest, Ratio, Proportion and Average, Mixture and Allegation, Time, Speed & Distance, Time & Work, Permutation & Combination, Probability, Pipes and Cisterns.	
Unit II - NON-VERBAL REASONING:	**08 Hours**
Coding, Decoding, Number series, Blood relation Directions, cubes & dices, Data Interpretation, Data Sufficiency, Set Theory & Syllogisms, Matching, Selection & Arrangement, Clocks & Calendars, Visual Reasoning, Input, Output & Flow Chart.	
Unit III - VERBAL REASONING:	**08 Hours**
Sentence Patterns, Sentence correction and spotting errors, Vocabulary, antonyms and synonyms and analogy, Phrasal Verbs, idiomatic expressions,	

reading comprehension, closest, sentence rearrangement and theme detection.	
Unit IV - SELF AWARENESS AND SOFT SKILLS DEVELOPMENT:	**08 Hours**
Concept of SWOT, Importance of SWOT, Individual & Organizational SWOT Analysis, Soft skills, meaning, need and importance, difference between soft skills and hard skills, life skills and personal skills, Leadership skills, -Importance, Types, Attributes of good leader Motivational theories and leadership, Emotional intelligence in personal and professional lives its importance needs and application, Team Building and conflict resolution Skills, Problem solving skills, Time Management and Stress Management Skills Pareto Principle (80/20) Rule in time management, Time management matrix, creativity and result orientation, working under pressure, stress management.	
Unit V - COMMUNICATION AND HONING EMPLOYMENT SKILLS:	**08 Hours**
Communication process, Non-verbal codes in communication, importance of LSRW in communication, Barriers to communication, Principles of effective Technical writing, Email writing and Netiquettes, Letter writing – formal letters, job application letter, cover letter, structure of technical report writing, Building Resume and CV, Tips to build an effective Resume Group discussion, Skills required for Group Discussion Interview skills, Ways of handling telephonic interviews, Importance of body language, grooming &etiquettes for getting right impression in PI&GD, Extempore, Introduction to PowerPoint presentation, Structure & flow of presentation.	
Unit VI – BUSINESS ETHICS, ETIQUETTES AND VALUES:	**08 Hours**
The Importance of Ethics and Values in Business World, Respect for Individuality and diversity at workplace values of a good manager Key features of corporate etiquette, corporate grooming & dressing, etiquettes in social & office Setting-Understand the importance of professional behavior at the work place, Corporate social responsibility (CSR) its importance and need.	

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Text Books:

1. Quantitative Aptitude by R. S. Agarwal published by S. Chand.
2. A Modern Approach to Logical Reasoning by R. S. Agarwal published by S. Chand.
3. Business Communication by Meenakshi Raman, Prakash Singh published by Oxford University press, second edition.
4. Communication Skills by Sanjay Kumar, Pushp Lata, published by Oxford University press, second edition.

Project Based Learning Topics:

1. Form a model for spoken and written communication skills which avoid grammar mistakes and common errors.
2. Develop various activity models for enriching and developing vocabulary.
3. Preparing strategies by using SWOT and TWOS analysis.

Soft Computing

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		**Marks**		**Credits**
Lecture:	**04 Hours/Week**	**University Examination:**	**60 Marks**		
Practical:	**-**	**Internal Assessment:**	**40 Marks**	**Lecture**	**04**
		Term Work	**-**		
		Oral	**-**		
		Total	**100 Marks**	**Total**	**04**

Course Objectives:

1. To study the various soft computing approaches.
2. To understand the soft computing techniques and algorithms for problem solving.
3. To be familiar with the various application areas of soft computing.
4. To apply the soft computing techniques for developing intelligent systems
5. To Explore and solve problems using genetic Algorithms.
6. To Understand hybrid systems paradigm and Application Areas of Soft Computing.

Prerequisite:

The students should have knowledge of basics of Computer Graphics.

Course Outcomes: At the end of this course, students will demonstrate the ability to:

1. Understand requirement of soft computing and be aware of various soft computing techniques.
2. Understand Artificial Neural Network and its characteristics and implement ANN algorithms.
3. Understand and Implement Evolutionary Computing Techniques.
4. Understand the Fuzzy logic and implement fuzzy algorithms for solving real life problems.
5. Apply knowledge of Genetic algorithms for problem solving.
6. Develop hybrid systems for problem solving.

Unit I - Introduction to Soft Computing	**08 Hours**
Introduction to Soft Computing and Computational Intelligence, Characteristics of Soft computing, Comparison Soft Computing Vs Hard Computing, Requirements of Soft Computing, Soft Computing Techniques – Artificial Neural Network, Fuzzy Logic., Evolutionary computing and Hybrid systems, Applications of Soft Computing.	
Unit II - Artificial Neural Network	**08 Hours**
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation, functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro associative memory, perceptron model, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule coefficient; back propagation algorithm, factors affecting backpropagation training, applications.	
Unit III - Evolutionary Computing	**08 Hours**
Problem Solving as A Search Task, Hill Climbing and Simulated Annealing, Evolutionary Computing, Evolution Strategies, Evolutionary Programming, Genetic Programming, Selected Applications From The Literature: A Brief Description, Scope Of Evolutionary Computing, Introduction to Evolutionary Single-Objective	

Optimization, Particle Swarm Optimization: Introduction, inspiration, mathematical model, standard and binary PSO. Artificial hummingbird Algorithm.	
Unit IV - Fuzzy logic	**08 Hours**
Introduction to Fuzzy Logic, Classical Set, Fuzzy Set- Introduction, Operations on classical sets, properties of classical sets, fuzzy set operations, properties of fuzzy sets, Classical Relation, Fuzzy Relation, Fuzzy Inference process – Membership functions, Fuzzification, Membership value Assignment- Inference, Rank ordering, defuzzification – Weighted Average Method, Mean-Max Membership, Fuzzy Bayesian Decision Making, Developing a Fuzzy Control – System Architecture and Operation of FLC System, FLC System Models, Application of FLC System.	
Unit V - Genetic Algorithm	**08 Hours**
Introduction To Basic Terminologies in Genetic Algorithm: Individuals, Genes, Fitness, Populations; Simple GA; General Genetic Algorithm; Operators in Genetic Algorithm: Encoding, Selection, Crossover (Recombination), Mutation; Stopping Condition for GA Flow; Constraints in Genetic Algorithms; Problem Solving Using Genetic Algorithm; Holland Classifier System: The Production System, The Bucket Brigade Algorithm and Rule Generation; Advantages and Limitations of Genetic Algorithms; Applications of Genetic Algorithms.	
Unit VI – Hybrid System and Application Areas of Soft Computing	**08 Hours**
Hybrid System towards comprehensive Soft Computing: The hybrid systems paradigm, Hybrid connectionist production systems, Hybrid connectionist logic programming systems, Hybrid fuzzy connectionist production systems, Hybrid systems for speech and language processing, Hybrid systems for decision making. Application Areas of Soft Computing: Fuzzy-filtered Neural Networks-Plasma Spectrum Analysis, Hand-written Numeral Recognition, Fuzzy sets and Genetic Algorithms in Game Playing, Soft Computing for Color Recipe Prediction.	

Textbooks

1. S.N. Sivanandam, ―Principles of Soft Computing‖, Wiley India- ISBN- 9788126527410
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani,―Neuro-Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence‖, Prentice Hall.
3. L. N. de Castro, ―Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications‖, 2006, CRC Press, ISBN-13: 978-1584886433 (Chapter 3).
4. S.Rajasekaran, and G. A. Vijayalakshmi Pai, ―Neural Networks, Fuzzy Logic and Genetic Algorithms : Synthesis, and Applications‖, Prentice Hall of India.

Reference Books

1. Nikola K. Kasabov, ―Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering‖, MIT Press.
2. Seyedali Mirjalili, ―Evolutionary Algorithms and Neural Networks Theory and Applications, Studies in Computational Intelligence‖, Vol 780, Springer, 2019, McGraw Hill.
3. Timothy J. Ross, ―Fuzzy Logic with Engineering Applications‖, Wiley India.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Computer Lab-III (R Programming)

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		**Marks**		**Credits**
Lecture:	**---**	**University Examination:**	**00 Marks**		
Practical:	**02 Hours/Week**	**Internal Assessment:**	**00 Marks**	**Lecture**	
		Term Work	**25 Marks**	**Practical**	**01**
		Practical	**25 Marks**		
		Total	**50 Marks**	**Total**	**01**

Course Outcomes: On completion of the course, students will have the ability to:

1. Learn Fundamentals of R.
2. Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions.
3. Cover the Basics of statistical data analysis with examples.

Unit I Introduction to R	**06 Hours**
Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations.	
Unit II Control structures and Vectors	**06 Hours**
Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes. Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations.	
Unit III Lists	**06 Hours**
Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations.	
Unit IV Factors and Tables	**06 Hours**
Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Sub table,	

Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions	
Unit V Object Oriented Programming	**06 Hours**
S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation.	

Textbooks

1. Roger D. Peng, "R Programming for Data Science", 2012
2. Norman Matloff," The Art of R Programming- A Tour of Statistical Software Design", 2011,

Reference Books

1. Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014
2. Venables , W.N.,and Ripley,"S programming", Springer, 2000.

List of Assignments

(Unit wise minimum 3 questions.)

Lab Assignment (Using Different Ids for Cross Platform):

1. How to Execute simple R Program.
2. R Program to execute Arithmetic Operation.
3. R Program to perform operations on vectors.
4. R Program to Implement Vector arithmetic and logical operations.
5. R Program to Implement Matrix Operations.
6. R Program to Implement List Operations.
7. Implementation of Data frame.
8. Implementation of Factors.
9. Implementation of S classes and Generic Functions

Project Based Learning:

1. Mini Project based on the content of the syllabus (Group of 2-3 students).