B. Tech. Syllabus (2024)

[Information Technology]

As per NEP 2020

(Approved by the 112^{th} Academic Council held on 30^{th} May, 2024 and adjourned on 21^{st} June, 2024)

Department of Information Technology

North-Eastern Hill University

Shillong - 793 022

Meghalaya

Mission:

1. To advance knowledge and skills in the fields of Information Technology with a motivation to produce globally competitive professionals and researchers.
2. To create wealth and welfare for the fulfilment of societal needs by solving technological challenges with socio-ethical implications.
3. To create a multi-disciplinary educational curriculum, research opportunities, and collaboration that promote creativity, innovation, invention, and entrepreneurship for the growth of the nation.

Vision: To become a globally recognized department of higher learning that aims to produce quality engineers, technologists, and innovators in the field of Information Technology for solving technological challenges with socio-ethical implications for the benefit of humanity.

Programme Objectives

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

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

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

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

MODEL COURSE STRUCTURE & THEME

0.1 Definition of Credit

1 Hr. Lecture (**L**) per week	1 Credit
1 Hr. Tutorial (**T**) per week	1 Credit
2 Hours Practical (**P**) per week	1 Credit

0.2 Total Credits

The total credit of four year undergraduate degree program in Information Technology is kept 160. The total credits equally divided in each semester of 20 credits.

0.3 Structure of UG Program in Technology

The structure of UG program in Technology shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	Category	Breakup of Credits	Papers
1	Humanities and Social Science Courses	11	04
2	Basic Science Courses	18	06
3	Engineering Science Courses	15	05
4	Professional Core Courses (Branch specific)	72	26
5	Professional Elective Courses (Branch specific)	11	03
6	Open Elective Courses (from Humanities, Technical Emerging or other Subjects)	10	03
7	Project work, Seminar and Internship in Industry or elsewhere	23	04
8	Audit Courses [Environmental Sciences, Indian Constitution]	(non-credit)	02
TOTAL		**160**	**53**

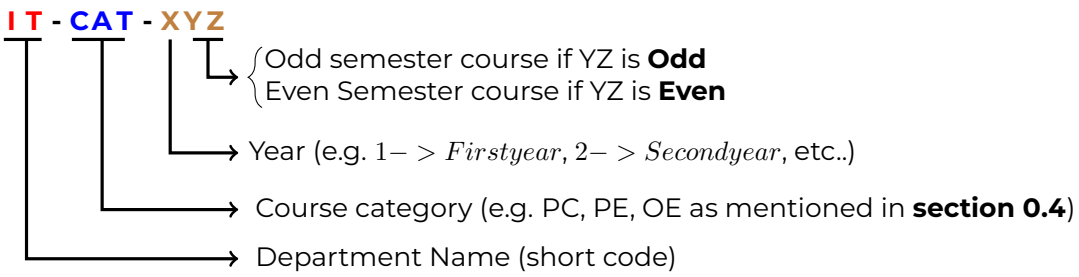
0.4 Course code and definition

Course code	Definition
L	Lecture
T	Tutorial
P	Practical
C	Credits
BS	Basic Science Courses
ES	Engineering Science Courses
HSM	Humanities & Social Science including Management Courses
PC	Professional Core Courses
PE	Program Elective Courses
OE	Open Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
AU	Audit Courses

0.5 Course level coding scheme

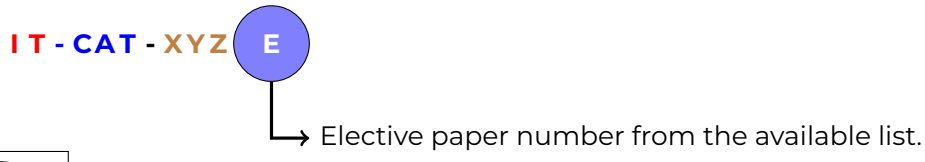
Course Coding for Core Papers:

The paper code starts with department name followed by Course Category for identifying the level of the course. Digit at hundred's place signifies the year in which course is offered and remaining two-digits represents semester number (odd numbers for the odd semester courses and even numbers for even semester courses) e.g.:



Course Coding for Elective Papers:

The format remains same as the core papers but with an additional number to represent the elective number in the list e.g.:



0.6 Induction Program

The essence and details of Induction Program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal.

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	Physical activity
	Creative Arts
	Universal Human Values
	Literary
	Proficiency Modules
	Lectures by Eminent People
	Visits to local Areas
	Familiarization to Dept./Branch & Innovations

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1. Syllabus Scheme

1.1 Semester: I

Branch: *Information Technology* **Year:** I **Semester:** I

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-HSM-101	Universal Human Values-II	3	0	0	15	15	30	45	75	3
2	IT-BS-103	Engineering Mathematics I	3	1	0	20	20	40	60	100	4
3	IT-ES-105	Basic Electrical Engineering	3	1	0	20	20	40	60	100	4
4	IT-PC-107	Computer System Fundamentals	3	0	0	15	15	30	45	75	3
5	IT-PC-109	Python Programming	2	0	0	10	10	20	30	50	2
Practical/Design/Laboratory/Seminar											
6	IT-ES-LC-111	Engineering Graphics and Design Lab	0	0	4	10	10	20	30	50	2
7	IT-ES-LC-113	IT Workshop	0	0	4	10	10	20	30	50	2
Audit Course											
8	IT-AU-115	Indian Constitution	2	0	0	20	30	50	-	50	-
		Total	**16**	**2**	**8**				**300**	**500**	20

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *26* **Total Marks:** *500* **Total Credits:** *20*

1.2 Semester: II

Branch: *Information Technology* **Year:** I **Semester:** II

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-HSM-102	Professional Communication Skill	3	0	0	15	15	30	45	75	3
2	IT-BS-104	Engineering Physics	3	0	0	15	15	30	45	75	3
3	IT-BS-106	Engineering Mathematics II	3	0	0	15	15	30	45	75	3
4	IT-ES-108	Basic Electronics	3	0	0	15	15	30	45	75	3
5	IT-PC-110	Programming in C	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar											
6	IT-BS-LC-112	Engineering Physics Lab	0	0	4	10	10	20	30	50	2
7	IT-PC-LC-114	C Programming Lab	0	0	4	10	10	20	30	50	2
8	IT-HSM-LC-116	Professional Communication Skill Lab	0	0	2	5	5	10	15	25	1
Audit Course											
9	IT-AU-118	Environmental Science	2	0	0	20	30	50	-	50	-
Audit Course											
		Total	**17**	**0**	**10**				**300**	**500**	20

Exit/Entry provision after the first year of B.Tech. programme shall be as per the provisions laid down in RC-20.

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *27* **Total Marks:** *500* **Total Credits:** *20*

Note: Exit/Entry provision after the first year of B.Tech. The programme shall be as per B.Tech Regulation RC-20.

1.3 Semester: III

Branch: *Information Technology* **Year:** II **Semester:** III

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-HSM-201	Engineering Economics and Management	3	1	0	20	20	40	60	100	4
2	IT-PC-203	Discrete Mathematics	3	0	0	15	15	30	45	75	3
3	IT-BS-205	Statistics and Random Processes	3	0	0	15	15	30	45	75	3
4	IT-PC-207	Data Structure and Algorithm	3	0	0	15	15	30	45	75	3
5	IT-PC-209	Computer Graphics and Multimedia	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar											
6	IT-PC-LC-211	Data Structure Lab	0	0	4	20	0	20	30	50	2
7	IT-PC-LC-213	Computer Graphics and Multimedia Lab	0	0	4	20	0	20	30	50	2
		Total	**15**	**1**	**8**				**300**	**500**	20

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *24* **Total Marks:** *500* **Total Credits:** *20*

1.4 Semester: IV

Branch: *Information Technology* **Year:** II **Semester:** IV

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-BS-202	Biology for Engineers	3	0	0	15	15	30	45	75	3
2	IT-ES-204	Digital Electronics	3	1	0	20	20	40	60	100	4
3	IT-PC-206	Theory of Computation	3	0	0	15	15	30	45	75	3
4	IT-PC-208	Relational Database Management System	3	0	0	15	15	30	45	75	3
5	IT-PC-210	Object Oriented Programming	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar											
6	IT-PC-LC-212	Relational Database Management System Lab	0	0	4	20	0	20	30	50	2
7	IT-PC-LC-214	Object Oriented Programming Lab	0	0	4	20	0	20	30	50	2
		Total	**15**	**1**	**8**				**300**	**500**	20

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *24* **Total Marks:** *500* **Total Credits:** *20*

Note: Exit/Entry provision after the first year of B.Tech. The programme shall be as per B.Tech Regulation RC-20.

1.5 Semester: V

Branch: *Information Technology* **Year:** III **Semester:** V

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-PC-301	Computer Network	3	1	0	20	20	40	60	100	4
2	IT-PC-303	Computer Organization and Architecture	3	0	0	15	15	30	45	75	3
3	IT-PC-305	Operating System	3	0	0	15	15	30	45	75	3
4	IT-PC-307	Compiler Design	3	0	0	15	15	30	45	75	3
5	IT-OE-309E	Open Elective-I	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar											
6	IT-PC-LC-311	Computer Network Lab	0	0	4	10	10	20	30	50	2
7	IT-PC-LC-313	Operating System Lab	0	0	4	10	10	20	30	50	2
		Total	**15**	**1**	**8**				**300**	**500**	20

MOOCs courses shall be approved by the Department of I.T. before registration.

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *24* **Total Marks:** *500* **Total Credits:** *20*

Open Elective-I

1. IT-OE-3091 Data Science and Analytics
2. IT-OE-3092 Natural Language Processing
3. IT-OE-3093 Graph Theory and its Application
4. IT-OE-3094 Game Theory
5. IT-OE-309E MOOCs Course-II

(For MOOCs-I Course **E** varies from 5-7)

1.6 Semester: VI

Branch: *Information Technology* **Year:** III **Semester:** VI

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-PC-302	Algorithm Analysis and Design	3	1	0	20	20	40	60	100	4
2	IT-PC-304	Software Engineering	3	1	0	20	20	40	60	100	4
3	IT-PC-306	Introduction to Cyber Security	3	1	0	20	20	40	60	100	4
4	IT-PE-308E	Program Elective-I	3	1	0	20	20	40	60	100	4
Practical/Design/Laboratory/Seminar											
5	IT-PC-LC-310	Web Technology Lab	0	0	4	10	10	20	30	50	2
6	IT-PC-LC-312	Cyber Security Lab	0	0	4	10	10	20	30	50	2
		Total	**12**	**4**	**8**				**300**	**500**	20

MOOCs courses shall be approved by the Department of I.T. before registration.

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *24* **Total Marks:** *500* **Total Credits:** *20*

Program Elective-I

1. IT-PE-3081 Digital Image Processing
2. IT-PE-3082 Robotics
3. IT-PE-3083 Bioinformatics
4. IT-PE-3084 Internet of Things
5. IT-PE-3085 Artificial Intelligence
6. IT-PE-308E MOOCs Course-I

(For MOOCs-II Course **E** varies from 6-8)

Note: Exit/Entry provision after the first year of B.Tech. The programme shall be as per B.Tech Regulation RC-20.

1.7 Semester: VII

Branch: *Information Technology* **Year:** IV **Semester:** VII

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-PC-401	Machine Learning	3	0	0	15	15	30	45	75	3
2	IT-PE-403E	Program Elective-II	3	1	0	20	20	40	60	100	4
3	IT-PE-405E	Program Elective-III	3	1	0	20	20	40	60	100	4
4	IT-OE-407E	Open Elective-II	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar/Minor Project											
5	IT-P-409	Minor Project	0	0	12	60	-	60	90	150	6
		Total	**12**	**2**	**12**				**300**	**500**	20

MOOCs courses shall be approved by the Department of I.T. before registration.

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *26* **Total Marks:** *500* **Total Credits:** *20*

Program Elective-II

1. IT-PE-4031 Advanced Computer Architecture
2. IT-PE-4032 Quantum Computing
3. IT-PE-4033 Pattern Recognition
4. IT-PE-4034 Wireless Networks
5. IT-PE-4035 Human Computer Interface
6. IT-PE-403E MOOCs Course-III

(For MOOCs-III Course **E** varies from 6-8)

Program Elective-III

1. IT-PE-4051 Data Mining
2. IT-PE-4052 Mobile Computing
3. IT-PE-4053 Advanced Cryptography
4. IT-PE-4054 Distributed Systems
5. IT-PE-405E MOOCs Course -IV

(For MOOCs-IV Course **E** varies from 5-7)

Open Elective-II

1. IT-OE-4071 Operation Research
2. IT-OE-4072 Soft Computing
3. IT-OE-4073 Cloud Computing
4. IT-OE-4074 Cyber Forensics and Law
5. IT-OE-4075 Simulation and Modelling
6. IT-OE-407E MOOCs Course-V

(For MOOCs-V course **E** varies from 6-8)

1.8 Semester: VIII

Branch: *Information Technology* **Year:** IV **Semester:** VIII

Sl. No.	Course Code	Course Name	Periods (Contact Hours)			Evaluation Scheme (Distribution of Marks)					**Credits**
Papers			**L**	**T**	**P**	**TA**	**CT**	**ST**	**ESE**	**TOT**	
1	IT-OE-402E	Open Elective-III	3	0	0	15	15	30	45	75	3
Practical/Design/Laboratory/Seminar/Minor Project/Viva-voce/Internship											
2	IT-P-404	Major Project	-	-	24	120	-	-	180	300	12
3	IT-P-406	Grand Viva	-	-	-	-	-	-	50	50	2
4	IT-P-408	Internship	-	-	-	-	-	-	75	75	3
		Total	**3**	**0**	**24**				**370**	**500**	20

MOOCs courses shall be approved by the Department of I.T. before registration.

L - Lecture **T -** Tutorial **P -** Practical **TA -** Assesment by Teacher/Supervisor
CT - Class Test **ST -** Sub-Total **ESE -** End Semester Evaluation **TOT -** Total

Contact Hours: *27* **Total Marks:** *500* **Total Credits:** *20*

Open Elective - III

1. IT-OE-4021 E-Commerce
2. IT-OE-4022 Management Information System
3. IT-OE-4023 Deep Learning
4. IT-OE-4024 Entrepreneurship
5. IT-OE-4025 Information Theory and Coding
6. IT-OE-4026 Research Methodology
7. IT-OE-402M MOOCs Course-VI

(For MOOCs-VI Course M varies from 7-8)

2. Detailed Syllabus

L	-	T	-	P	Cr.
3	-	0	-	0	3

2.1 First Semester

2.1.1 IT-HSM-101 Universal Human Values-II

Course Code	:	$IT - HSM - 101$
Course Name	:	*Universal Human Values-II*
Contact Hours per Week	:	*(Three) Hours.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to

1. Develop a holistic perspective based on self-exploration about themselves, family, society and nature/existence.
2. Understand harmony in the human being, family, society and nature/existence
3. Strengthen self-reflection and develop commitment and courage to act.

Course Outcomes: After completion of the course, students will be able to:

1. Increase self-awareness and awareness of surroundings (family, society, nature)
2. Develop responsibility in life and problem-solving with sustainable solutions considering human relationships and human nature.
3. Increase sensitivity to their commitment to understanding and upholding human values, relationships, and society.
4. Apply learned concepts to various real-life situations

Unit I
Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, Self-exploration, Continuous Happiness and Prosperity, Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity correctly, Method to fulfil the human aspirations. *Understanding Harmony in the Human Being - Harmony in Myself!:* Human being as a co-existence of self ('I') and the 'Body', Needs of 'I' and 'Body', Body as an instrument of 'I', Characteristics and activities of 'I' and harmony in 'I', Harmony of 'I' with the Body, Programs to ensure Sanyam and Health.

Unit II
Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship: Values in human-human relationship, Meaning of Trust, Meaning of Respect, Harmony in the society, Visualizing a universal harmonious order in society. *Understanding Harmony in the Nature and Existence - Whole existence as Coexistence:* Harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Existence as Co-existence of mutually interacting units, Holistic perception of harmony at all levels of existence.

Unit III
Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order.

Text Books:

1. R. R. Gaur, R. Sangal, G. P. Bagaria, *Human Values and Professional Ethics*, Excel Books, 2010.
2. A. N. Tripathi, *Human Values*, New Age International Pvt. Ltd., 2019.

Reference Books:

1. P. Singh, D. Panwar, *Human Values & Professional Ethics*, Krishna Prakashan, 2010.
2. M. K. Gandhi, *The Story of My Experiments with Truth-Autobiography*, The Floating Press, 2009.

2.1.2 IT-BS-103 Engineering Mathematics I

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-BS-103$
Course Name	:	*Engineering Mathematics I*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Apply principles of calculus, complex analysis, and linear algebra to solve mathematical problems and demonstrating proficiency in differential and integral calculus techniques, complex number operations, and linear algebra concepts.
2. Utilize understanding of complex numbers, including their algebraic and geometric properties, complex plane representation, and analytic functions, to evaluate contour integrals
3. Utilize linear algebra concepts to analyze vector spaces, matrices, and linear transformations, including understanding subspaces, bases, dimensions, systems of linear equations, eigenvalues, eigenvectors, and diagonalization techniques.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the importance of calculus and Linear Algebra in solving Mathematical problems.
2. Understand the basics of Complex analysis and its importance.
3. Understand the importance of Laplace and Fourier transformations and its role in solving differential equations.

Unit I
Differential Calculus of Single Variable: Functions, continuity and differentiability (with emphasis on hyperbolic and inverse hyperbolic functions), Properties of continuous functions on closed intervals, Intermediate value theorem and its applications, Successive differentiation; Taylor's and Maclaurin's series; L'Hospital rule (statements only with applications)

Unit II
Complex analysis: Analytic functions, Cauchy-Riemann equations, Cauchy's integral theorem, Cauchy's integral formula, Taylor series and Laurent series. Residues and their applications to evaluating real integrals (statements only with applications).

Unit III
Laplace and Fourier Transforms: Laplace transforms, existing theorem, Inverse transform., Shifting on the s andtaxes, Laplace transform of derivatives, convolutions, partial fractions, Fourier transforms, Solutions of ordinary differential equations by Laplace transforms.

Unit IV
Linear Algebra: Vector space over the field of real and complex numbers, subspaces, bases and dimension; Elementary row and column operations; echelon form; system of linear equations; Eigen values and eigen vectors; Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal matrices.

Text Books:

1. E. Kreyszig, *Advanced Engineering Mathematics*, 7th Ed. John Wiley & Sons Inc., 2017.
2. S. Pal and S. C. Bhunia, *Engineering Mathematics*, Oxford University Press, 2015.
3. R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, 5th ed. Narosa Publishing House, 2016.

Reference Books:

1. B. Ram, *Engineering Mathematics-I*, 1st ed. Pearson Education India, 2012.
2. S. S. Sastry, *Engineering Mathematics*, 4th ed. PHI Learning Pvt. Ltd., 2009.
3. M. C. Potter, J. L Goldberg and E.F. Aboufadel, *Advance Engineering Mathematics*, 3rd ed. Oxford University Press, 2005.

2.1.3 IT-ES-105 Basic Electrical Engineering

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-ES-105$
Course Name	:	*Basic Electrical Engg*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the basic concept of Electrical Engineering.
2. understand the basics of Series and Parallel Circuits.
3. understand the practical aspect of it and enable them to detect the basic electrical faults and their remedial measures.

Course Outcomes: After completion of the course, students will be able to:

1. Understand basics of Circuit Theory
2. Differentiate between AC and DC circuits.
3. Understand the working of Motors and Generators both AC and DC.

Unit I
Engineering Circuit Analysis: Circuit elements, Ohm's law, Kirchoff's law, Nodal Analysis, Mesh Analysis, Source transformations, Linearity and Superposition, Thevenin's and Norton's Theorems, Maximum power transfer theorem, Star-Delta and Delta-Star Conversion.

Unit II
Series and Parallel RLC Circuits: Simple RL and RC Circuits, Unit Step Forcing Function, source free RLC Circuits, Sinusoidal Forcing Function, Complex Forcing Function, Phasor Concept, Impedance and Admittance, Phasor diagrams, Response as a Function of, Instantaneous Power, Average Power, RMS values of Current and Voltage, Apparent Power and Power Factor, Complex Power, Introduction to Three Phase Circuits.

Unit III
DC Machines: Principle of DC Generator, Methods of excitation, Characteristics and Applications, Principle of DC Motor, Types, Speed – Torque Characteristic, Speed Control. *Transformers*: Working principle of Transformers, Induction Motor: Construction, Production of rotating field, Slip, Torque and Slip, Single Phase Induction Motor.

Unit IV
Electrical Utilization and Basics of Power system: Domestic wiring structure, Basic structure of the Power system from the Generating House to Domestic supply, Some basic practical faults in domestic power system, Essence of earthing.

Text Books:

1. A. Sudhakar and S. S. Palli, *Circuits and Networks Analysis and Synthesis*, 2nd ed. McGraw Hill Publications, 2015.
2. B. L. Theraja, *A Text Book of Electrical technology*, S. Chad and Company Ltd, 1994.

Reference Books:

1. D. Ashby, *Electrical Engineering 101*, 3rd ed. O'Reilly, 2011.
2. W. Hayt and J. E. Kemmerly, *Engineering Circuit Analysis*, 9th ed. McGraw Hill Publications, 2022.

2.1.4 IT-PC-107 Computer System Fundamentals

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-107$
Course Name	:	*Computer System Fundamentals*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand computer fundamentals, including definition, characteristics, and historical evolution.
2. Gain proficiency in memory hierarchy concepts and various types of computer memory.
3. Develop skills in number systems, computer codes, Boolean algebra, software types, and programming planning techniques.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate a comprehensive understanding of computer architecture, memory organization, and storage systems.
2. Apply knowledge of number systems, computer codes, and Boolean algebra in solving computational problems effectively.
3. Identify and differentiate between system software, utility software, and programming languages, and effectively plan and design computer programs.

Unit I
Introduction: Introduction to Computers - Computer Definition, Characteristics of Computers, Evolution and History of Computers, Types of Computers, Basic Organization of a Digital Computer; Memory: Memory hierarchy, Registers (Types of Registers), Cache Memory. Primary Memory- RAM, DRAM and SRAM. ROM, BIOS/Firmware & Types of ROM. Secondary Memory.

Unit II
Number Systems: Different types, conversion from one number system to another; Computer Codes – BCD, Gray Code, ASCII and Unicode; Boolean Algebra – Boolean Operators with Truth Tables;

Unit III
Types of Software: System Software and Utility Software; Computer Languages - Machine Level, Assembly Level & High Level Languages, Translator Programs – Assembler, Interpreter and Compiler; Planning a Computer Program - Algorithm, Flowchart and Pseudo code with Examples.

Text Books:

1. P. K. Sinha and P. Sinha, *Computer Fundamentals*, BPB Publications, 2007.
2. A. Goel, *Computer Fundamentals*, Pearson Education, 2010.

Reference Books:

1. T. L. Floyd, *Digital Fundamentals*, 9th ed. Pearson Education India, 2018.
2. A. P. Malvino and D. P. Leach, *Digital Principle and Applications*, 8th ed. McGraw-Hill, 1986.

2.1.5 IT-PC-109 Python Programming

L	-	T	-	P	Cr.
2	-	0	-	0	2

Course Code	:	$IT-PC-109$
Course Name	:	*Python Programming*
Contact Hours per Week	:	*Lecture-2, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2 (Two) Hours.*

Course Objectives: The objectives are to:

1. Gain a basic understanding of Python programming constructs.
2. Learn to write Python programs.
3. Solve simple problems through Python programming.

Course Outcomes: After completion of the course, students will be able to:

1. Enrich coding skills with Python programming.
2. Develop logical skills to solve problems.
3. Build simple projects using Python programming language.

Unit I
Introduction to Python: Python Syntax contrasted(compared) with other programming dialects or languages, Python Install.

Beginning Python Basics: The print statement Comments, Python Data Structures & Data Types, String Operations in Python, Simple Input & Output, Simple Output Formatting, Operators in python.

Python Program Flow: Indentation: The If statement and its' related statement(assertion), An example with if and it's related statement(explanation), The while loop, The for loop, The range statement, Break & Continue, Assert, Examples for looping

Unit II
Functions & Modules: Create your own functions, Functions Parameters, Variable Arguments, Scope of a Function, Function Documentations, Lambda Functions & map, Exercise with functions Create a Module Standard Modules.

Exceptions Handling: Errors, Exception handling with try, handling Multiple Exceptions, Writing your own Exception.

Text Books:

1. A. Downey, *Think Python*, O'Reilly Media, Inc., 2015.
2. R. Thareja, *Python Programming: Using Problem Solving Approach*, Oxford University Press, 2023.

Reference Books:

1. M. Lutz, *Python Pocket Reference*, 5th Ed. O'Reilly Media, February 2014.
2. A. Martelli, *Python in a Nutshell, 3rd Edition*, O'Reilly Media, May 2017.
3. D. Brueck and S. Tanner, *Python 2.1 Bible*, Wiley, 2001.

2.1.6 IT-ES-LC-111 Engineering Graphics and Design Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-ES-LC-111$
Course Name	:	*Engineering Graphics & Design Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Develop proficiency in fundamental drawing techniques including sheet layout, sketching, lines, lettering, and dimensioning.
2. Master geometric construction methods for bisecting lines, creating perpendicular lines, dividing lines, and constructing polygons.
3. Develop skills in sectional views of solids and isometric projection of geometric solids.

Course Outcomes: After completion of the course, students will be able to:

1. Effectively layout sheets, sketch objects, and apply appropriate lines, lettering, and dimensioning in technical drawings.
2. Demonstrate proficiency in geometric construction techniques, including bisecting lines, constructing polygons, and creating perpendicular lines.
3. Understand the properties and construction methods of conics and engineering curves, enabling them to apply these concepts in practical engineering drawings.

List of Drawing Plates/Sheets:

1. Introduction of Drawing (Sheet layout and Sketching, lines, Lettering and Dimensioning).
2. Geometrical Constructions (Bisecting a lines, Perpendicular lines, divide a lines, Construction of Polygons).
3. Conics and Engineering Curves (Ellipse, Parabola, Hyperbola).
4. Conics and Engineering Curves (Cycloid, Epicycloid, Hypocycloid, Trochoid, Involute).
5. Projection of Points.
6. Projection of Lines.
7. Projection of Planes.
8. Projection of Solid (Cube, Prism, Pyramids, Cylinder, Cone and Sphere)
9. Section of Solid.
10. Isometric projection of solids (Prisms, Pyramids, Cylinders, Cone and Sphere).

Text Books:

1. T. E. French, C.J. Vierck and R. J. Foster, *Engineering Drawing and Graphics Technology*, McGraw-Hill Education, 1993.
2. N. D. Bhatt and V.M. Panchal, *Elementary Engineering Drawing*, Charotar Publishing House, 1996.

Reference Books:

1. K. Venugopal, *Engineering Drawing and Graphics*, New Delhi: New Age International publication, 2011.
2. D. A. Johle, *Engineering Drawings*, 1st ed. McGraw Hill Education Pvt. Ltd., 2017.

2.1.7 IT-PC-LC-113 IT Workshop

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-113$
Course Name	:	*IT Workshop*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on a lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Familiarize with the syntax and semantics of Python and Scilab scripting language
2. get introduced with the integrated development environment for program development in python and scilab
3. Understand various built-in data structures and library functions.

Course Outcomes: After completion of the course, students will be able to:

1. Give the step-by-step representation of a computational problem in the English language, the student should be able to convert it into a program in Python/ Scilab.
2. Use the above skill to develop a useful project using his/her creativity.

List of Programs:

1. Interactive programs to familiarize the different data types and operators
2. Programs related to different flow control.
3. Programs related to statistical and numerical operations.
4. Programs using functions
5. Programs related to set, vectors and matrix operations
6. Programs related to solving linear equations.
7. Programs related to lists and its operations
8. Programs related to strings and its operations.
9. Programs related to file handling
10. Programs related to visualization of data.

Text Books:

1. O. Allen, J. Elkner, and C. Meyers, *How to Think Like a Computer Scientist: Learning with Python*, Green Tea Press, 2002.
2. S. Taneja, N. Kumar, *Python Programming A Modular Approach with Graphics, Database, Mobile, and Web Applications*, 1st ed. Pearson, 2017.

Reference Books:

1. A. B. Downey, *Think PYTHON*, 4th ed. O'Rielly, Indian Reprint, 2015.
2. D. Hellmann, *The Python 3 standard Library by Example (Developers Library)*, 1st ed. Addison-Wesley Professional, 2017.

2.1.8 IT-AU-115 Indian Constitution

L	-	T	-	P	Cr.
2	-	0	-	0	-

Course Code	:	$IT - AU - 115$
Course Name	:	*Constitution of India.*
Contact Hours per Week	:	*Lectures-2, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 50.*

Course Objectives: The objectives are to:

1. Know the importance of Constitution and Government
2. Become a good Citizens and know their fundamental rights, duties, and principles.
3. Learn about emergency provisions, amendments and various schedules.

Course Outcomes: After completion of the course, students will be able to:

1. Understand about Fundamental rights of the citizen along with fundamental duties.
2. Know about the constitutional principles of governance and basic features of the Constitution.

Unit I
Fundamental Aspect of the Constitution: The preamble, Form of constitution, Features of Indian Constitution, Citizenship (Part II). *Fundamental Rights (Part III)*: Directive Principle of state policy (Part IV), Fundamental Duties (Part IV-A).

Unit II
The Union (Part V), The States (Part VI), The Panchayat (Part IX), The municipalities (Part IX-A) The Schedule and Tribal Areas (Part X), Tribunals (Part6 XIV-A). Emergency provisions (Part XVIII), Amendment of the Constitution (Part XX), *Schedules*: Fifth Schedule, Sixth schedule, seventh schedule, Eight Schedule,

Text Books:

1. H. K. Saheray, *Constitution of India*, Eastern Law House, 2012.
2. M. B Jain, *Indian Constitutional Law*, 8th ed. LexiNexis, 2018.
3. D. D. Basu, *Constitution of India*, 26th ed. Educational Printed, 2022.

Reference Books:

1. S. C. Kashyap, *Our Parliament*, National Book Trust, 2021
2. B. Chandra, M. Mukherjee, A. Mukherjee, S. Mahajan, ans K. N. Panikar, *India's struggle for Independence*, Penguin UK, 2016.
3. S. C. Kashyiap, *Our Constitution: An Introduction to India's Constitution and Constitutional Law*, National Book Trust of India, 2008.
4. M. Laximikand, *Indian Polity*, 5th ed. McGraw Hill Education (India) Private Limited, 2023.

2.2 Second Semester

L	-	T	-	P	Cr.
3	-	0	-	0	3

2.2.1 IT-HSM-102 Professional Communication Skill

Course Code	:	$IT - HSM - 10$
Course Name	:	*Professional Communication Skill*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Sessional Works = 30, End Sem Examination = 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand and apply principles of effective communication, including identifying barriers and mastering verbal and non-verbal techniques.
2. Develop professional communication skills for various contexts, emphasizing clarity and professionalism.
3. Acquire knowledge of speech mechanisms and vocabulary enhancement techniques.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate effective communication skills, addressing barriers and utilizing appropriate techniques.
2. Apply principles of effective writing and vocabulary enhancement in practical communication.
3. Proficiently engage in business correspondence, report writing, presentations, and group discussions.

Unit I
General Principles of Communication and Oral Communication: The process of Communication, principles of Communication (Communication barriers, levels of Communication, communication network, verbal, non-verbal) and professional Communication. The Speech Mechanism, IPA Symbols (Vowels and consonant sound),minimal pairs, word transcription, stress and intonation, active listening, types of listening, traits of a good listener, active versus passive listening.

Unit II
Constituents of Effective Writing and Vocabulary: The sentence and its parts, articles, the verb phrase, tense and aspect, the active and passive, the adjective, interrogative and negative sentences, concord, preposition. Paragraph development, summary writing and reading, comprehension word formation processes: affixation, compounding, converting, use of words in different parts of speech, idioms and phrases.

Unit III
Business Correspondence and Communication Strategies: Characteristics of business Letter, Drafting: Bio-data/ Resume/Curriculum Vitae (Theory) Report writing: Structure. Type of Reports (Theory) Presentation skills, public speaking and grouping discussion (Theory) and Soft Skills (theory).

Text Books:

1. B. K. Das and K. Samantray, *An Introduction to professional English and Soft Skills*. New Delhi: Foundation Books, 2009.
2. R. C. Sharma and K. Mohan, *Business correspondence and Report Writing*, New Delhi: Tata McGraw Hill, 2002.
3. A. Doff, C. Jones, *Language in Use, Upper-Intermediate Classroom Book*, New Delhi: Cambridge University Press, 2004.

Reference Books:

1. J. D. O'Connor, *Better English Pronunciation*, London: Cambridge University Press, 2006.
2. P. Patnaik, *Group Discussion and Interview Skills*, New Delhi: Cambridge University Press, 2011.

2.2.2 IT-BS-104 Engineering Physics

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT - BS - 104$
Course Name	:	*Engineering Physics*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: After completion of the course, students will be able to:

1. Understand the principles of vibration and waves, including simple harmonic motion, superposition, damped and forced oscillations, and wave equations.
2. Gain knowledge of optics principles such as interference, diffraction, polarization, and optical activity.
3. Explore the interface between physics and engineering, focusing on the role of physics in various industrial applications and technologies.

Course Outcomes: The objectives are to:

1. Demonstrate proficiency in analyzing and solving problems related to vibration, waves, and optics.
2. Apply principles of physics to understand and analyze engineering systems and technologies.
3. Gain insight into the applications of physics principles in various engineering fields, including energy production, communications, and materials science.

Unit I
Vibration and Waves: Simple harmonic motion (SHM). Superposition of SHMs. Lissajous' figures, Damped oscillator, Forced oscillator, Wave equation and solution, Wave and particle velocity. Wave equation in string, Production, properties and application of ultrasonic waves.

Unit II
Optics: Fermat's principle of least time. Interference. Newton's rings experiment. Fresnel and Fraunhofer diffractions. Diffraction grating. Polarization of light. Nicol prism, Optical activity, Polarimeter.

Unit III
Physics-Engineering Interface (Qualitative): Role of physics in industrial revolution, Thermodynamic Rankine cycle, Otto cycle, steam engine, steam turbine, and Internal Combustion (IC) engine, Newton's gravitational law and Satellite; Faraday Law and electric motor and transformer; Total Internal reflection and fiber optical cable; Magnetic hysteresis and memory device; Nuclear fission and Nuclear power, Nuclear reactor and Nuclear Bomb; Semiconductor P-N junction and transistor, solar cell; Quantum confinement of an electron in potential box and Nanotechnology; Molecule rotational spectroscopy and microwave oven, Capacitor, and Supercapacitor Energy Storage; Quantum superposition and quantum technology.

Text Books:

1. H. K. Malik and A. K. Singh, *Engineering Physics*, 1st ed. Tata McGraw Hill Education Private Limited, 2011.
2. R. Dogra, *Engineering Physics*, 1st ed. S K Kataria & Sons, 2019.

Reference Books:

1. H. J. Pain, *The Physics of vibrations and waves*, 6th ed. John Wiley & Sons Inc, 2005.
2. R. W. Webb, *Elementary Wave Optics*, Dover Publication Inc, 2005.
3. H. Jeff, L. N. Rosenband, and M. R. Smith, *Reconceptualizing the Industrial Revolution*, The MIT Press, 2010.

2.2.3 IT-BS-106 Engineering Mathematics II

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-BS-106$
Course Name	:	*Engg Mathematics II*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. To develop proficiency in multivariable calculus concepts and their practical applications, including partial derivatives, gradients, directional derivatives, and optimization techniques.
2. To master numerical techniques for root finding, interpolation, numerical differentiation and integration, emphasizing methods such as bisection, interpolation, and Simpson's rules.
3. To attain proficiency in solving ordinary differential equations and model simple physical problems.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the importance of function of several variables and application of calculus of several variables.
2. Understand the needs of Numerical techniques and the associated methods to solve basic problems.
3. Understand the importance of differential equations in Mathematical modelling and master different methods to solve ordinary differential equations.

Unit I
Multivariable Calculus: Partial derivatives. Chain rule, Standard Jacobians for change of variables, Gradient and directional derivatives, Euler's theorem on homogeneous functions, Repeated and multiple integrals, maxima and minima for function of several variables.

Unit II
Numerical Methods: Bisection method, Newton-Rapson's and Secant methods for roots of nonlinear equations. Polynomial interpolation. Numerical Differentiation and Numerical integration, trapezoidal and Simpson's rules.

Unit III
Ordinary Differential Equations: Ordinary linear differential equations of nth order, solutions of homogeneous equations, Wronskian, Operator method (simple problems only with emphasis on second order homogeneous equations), Nonlinear equations and Clairaut's equations.

Text Books:

1. E. Kreyszig, *Advanced Engineering Mathematics*, Tenth Ed, John Wiley & Sons Inc., 2017.
2. S. Pal and S. C. Bhunia, *Engineering Mathematics* , Oxford University Press, 2015.
3. R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, 5th ed. Narosa Publishing House, 2016.

Reference Books:

1. B. Ram, *Engineering Mathematics*, Pearson, 2009.
2. Sastry, *Engineering Mathematics*, PHI, 2008.
3. M. C. Potter, J. L Goldberg and E.F. Aboufadel, *Advance Engineering Mathematics*, Oxford University Press, 2005.

2.2.4 IT-ES-108 Basic Electronics

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-ES-108$
Course Name	:	*Basic Electronics*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the properties of semiconductors, including energy bands, intrinsic and extrinsic semiconductors, carrier transport phenomena, and generation/recombination of carriers.
2. Gain knowledge of PN-junction diodes, including their characteristics, transition capacitance, and diffusion capacitance.
3. Learn about the applications of PN-junction diodes and special purpose diodes in rectifiers, clipping/clamping circuits, and various electronic devices.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing semiconductor properties and understanding the behavior of carriers in semiconductors.
2. Apply knowledge of PN-junction diodes in designing rectifiers and clipping/clamping circuits for electronic applications.
3. Understand the principles of transistors, including construction, operation, configurations, and characteristics, and their applications in amplification and electronic circuits.

Unit I
Properties of Semiconductors: Energy bands in solids, E-K Diagram; intrinsic & extrinsic semiconductors; carriers transport phenomena: drift & diffusion current, mobility & resistivity. Generation & recombination of carriers; Hall effect, PN-Junction Diode: General idea; characteristics; Transition capacitance and diffusion capacitance.

Unit II
Applications of PN-Junction Diodes: Half wave, full wave center-tapped and bridge rectifiers; Clipping & clamping circuits. Characteristics and Applications of Special Purpose Diodes: Zener, Photo, Varactor, Schottky, Tunnel diode & Light emitting diode, Photovoltaics.

Unit III
Transistors: Constructions, symbols, principle of operations, configurations and characteristics of BJT and FET(JFET & MOSFET), Application of BJT as amplifier, Unijunction Transistor (UJT),
Special Diodes: Tunnel Diode, Varactor diode, Schottky diode, CCD, Impatt diode, Gunn diode etc.- their characteristics and applications.

Text Books:

1. D. Chattopadhay and P. C. Rakshit, *Electronics Fundamentals and Applications*, 12th Ed., New Age International (P) Ltd., 2014.
2. J. Millman and C. Halkias, *Integrated Electronics*, 42nd Reprint, TMH, 2006.
3. R. Boylestead and L. Nashelsky, *Electronic Devices and Circuits Theory*, 9th Ed., PHI, 2006.

Reference Books:

1. M. S. Sukhija and T.K. Nagsarkar, *Basic Electrical and Electronics Engineering*, Oxford, 2012.
2. A. P. Malvino, *Electronic Principles*, 6th Ed., TMH, 1998.
3. R. P. Jain, *Modern Digital Electronics*, 3rd Ed., TMH, 2003

2.2.5 IT-PC-110 Programming in C

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-110$
Course Name	:	*Programming in C*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: After completion of the course, students will be able to:

1. Fmiliarize students to the fundamentals of programming using the C language.
2. Familiarize students with syntax, data types, control structures and various operators in C.
3. Explore advanced topics such as pointers, memory management, Structure and union in C.
4. Foster logical thinking and algorithmic problem-solving abilities through programming challenges.

Course Outcomes: The objectives are to:

1. Develop proficiency in C programming language syntax, data types, and control structures.
2. Develop the ability to design, implement, test, and debug C programs to solve computational problems.
3. Develop competency in using advanced features of C such as pointers, structures, functions and file I/O.

Unit I
Programming Using C: Overview of C, constants, variables, keywords, data types, operators and expressions, C instructions. Branching and looping operations. *Functions*: Function prototypes, defining a function, calling a function, passing arguments to a function and recursive function. Storage classes and C preprocessor.

Unit II
Arrays and Pointers: Defining an array, processing an array, multidimensional arrays, strings, string handling functions. Pointer fundamentals, pointer declarations, pointer arithmetic, pointer as function arguments, array of pointers, Dynamic memory allocations.

Unit III
Structures and Unions: Defining and processing of structure and union, array of structure, array within structure, passing of structure as function argument. File Management: Introduction, defining and opening a file, closing a file, input/output operations on files, error handling during I/O operations, random access to files, command line arguments.

Text Books:

1. E. Balaguruswami, *Programming in ANSI C*, 2nd Ed., Tata McGraw Hill, 2004.
2. Y. Kanetkar, *Let us C*, BPB Publication, 2004.

Reference Books:

1. R. Thareja, *Computer fundamentals and programming in C*, Oxford university press, 2013.
2. A. Kelley and I. Pohl, *A Book on C*, 4th Ed., Pearson Education, 1998.

2.2.6 IT-BS-LC-112 Engineering Physics Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$BS-LC-112$
Course Name	:	*Engineering Physics Laboratory*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on a lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Gain hands-on experience in performing experiments to determine various physical constants and properties.
2. Develop skills in using different experimental setups and instruments for precise measurements.
3. Understand the principles and theories behind each experiment and learn how to analyze experimental data.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in conducting experiments to determine physical constants such as acceleration due to gravity, rigidity modulus, wavelength of light, specific rotation, magnetic moment, resistance, and Planck's constant.
2. Understand the practical applications of experimental techniques and methods in physics and related fields.
3. Analyze experimental data accurately and draw conclusions based on scientific principles.

List of Experiments:

1. To determine the acceleration due to gravity by bar pendulum/Kater's pendulum.
2. To determine rigidity modulus of a wire by statistical method/dynamical method.
3. To find the wavelength of monochromatic light by using Newton's ring method.
4. To determine the wavelength of sodium light by Michelson's interferometer.
5. To determine the wavelength of prominent lines of mercury by plane diffraction grating.
6. To determine he specific rotation of sugar solution by polarimeter.
7. To determine the magnetic moment of a bar magnet (M) and the earth's horizontal intensity (H) (by deflection and vibration magnetometers).
8. To determine the resistance per unit length of a meter bridge wire by Carey- Foster Method.
9. Calibration of Ammeter and Voltmeter using potentiometer.
10. To study decay of current in RC circuit.
11. To study Lissajous figure using CRO
12. To determine frequency of a tuning fork by Melde's method.
13. To determine ultrasonic velocity in liquid.
14. To obtain the hysteresis curves (B-H) for a ferromagnetic material (thin rod or wire) on a CRO using solenoid and then to determine the related magnetic constants.
15. To determine the Planck's constant by a Photocell.
16. To determine the e/m value of an electron by any method.

Text Books:

1. S. K. Ghosh, *A Text book of Practical Physics*, New Central Book Agency, Kolkata, 2006.
2. Gupta and Kumar, *Practical Physics*, Pragati Prakashan, Meerut, U.P., 2005.
3. C. L. Arora, *Advance B.Sc. Practical Physics*, S. Chand, 2004.

Reference Books:

1. H. J. Pain, *The Physics of Vibrations and Waves*, 6th Ed., Wiley Student Edition, 2005.
2. P. V. Naik, *Principles of Physics*, Prentice Hall of India Pvt. Ltd., 2000.

2.2.7 IT-PC-LC-114 C Programming Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-114$
Course Name	:	*C Programming Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: After completion of the course, students will be able to:

1. Understand the fundamentals of C programming language.
2. Develop proficiency in writing, compiling, debugging, and testing C programs.
3. Explore various data types, control structures, array, structure and functions in C.

Course Outcomes: The objectives are to:

1. Understand the fundamental concepts and syntax of the C programming language.
2. Write efficient and reliable C programs to solve computational problems.
3. Utilize various data types, control structures, and functions effectively in C programming.

List of Programs:

1. Assignments on Operators and Expressions: C programs using operators and expressions.
2. Assignments on Branching: C programs using if, if-else, if-elseif-else, switch-case construct of C.
3. Assignments on Looping: C programs incorporating for loop, while loop and do-while loop.
4. Assignments on Array: C programs using array (1D and 2D)
5. Assignments on String: String manipulation and use of standard library functions in C.
6. Assignments on Function: C programs using function, Demonstration of call by-value and call-by-address, passing array (1D and 2D) to a function, C programs to understand recursive function.
7. Assignments on Pointer: C programs using pointer, function and array.
8. Assignments on Structure & Union: C program using structure, demonstration of difference between structure and union.
9. Assignments on File handling: C programs involving opening, closing, reading/writing and random access in a file.
10. Assignment on Command Line Arguments: C programs involving passing parameters through command line argument.

Text Books:

1. B. S. Gotfried, *Programming in C*, Schuam Outline Series, TMH, 2005.
2. Y. Kanetkar, *Let us C*, BPB Publication, 2004.
3. E. Balaguruswami, *Programming in ANSI C*, 2nd Ed., Tata McGraw Hill, 2004.

Text Books:

1. B. S. Gottfried, *Programming with C*, 2nd ed., Tata McGrawhill, 2007.
2. K. R. Venugopal and S. R. Prasad, *Mastering 'C'*, 3rd Ed., Tata McGrawHill, 2008.
3. B. W. Kernighan & D. M. Ritchie, *The C Programming Language*, 2nd ed., Pearson Education, 2001.

2.2.8 IT-HSM-LC-116 Professional Communication Skill Lab

L	-	T	-	P	Cr.
0	-	0	-	2	1

Course Code	:	$IT-HSM-LC-116$
Course Name	:	*Professional Communication Skill Lab*
Contact Hours per Week	:	*Practical-2, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 10, End Semester Examination: 15.*
Questions to be Set	:	*10 (Ten)*
Questions to be Answered	:	*Any one Question shall be allotted on a lottery basis.*
Duration of End Semester Examination	:	*2 (Two) Hours.*

Course Objectives: After completion of the course, students will be able to:

1. Develop effective social communication skills for interacting with others in various social contexts.
2. Enhance English language proficiency in grammar, pronunciation, and phonetics.
3. Cultivate advanced learning and soft skills such as effective communication, interview handling, and email etiquette.

Course Outcomes: The objectives are to:

1. Demonstrate proficiency in social communication, grammatical accuracy, and clear pronunciation in English.
2. Apply advanced learning and soft skills to succeed in professional and social situations.
3. Improve overall communication skills, including listening, speaking, reading, and writing, to effectively convey and understand information.

Laboratory Practices

Communications skills-Social:

1. Meeting people and asking questions
2. Making Friends
3. Dos and don'ts
4. What did you do

English Concept:

1. Grammer- Tenses
2. Grammer- Part of speech
3. Figure of speech
4. Direct and indirect speech

Pronunciation Phonetics- Intonations:

1. Vowels
2. Consonants
3. Noun

Advanced learning and soft skills:

1. Effective communication
2. Interview handling skills
3. E-mail entiquette

Communication skills Listening- speaking- Reading:

1. Listening skills
2. Speaking skills
3. Reading skills
4. Writing skills

Text Books:

1. Jones and Daniel, Cambridge English Pronouncing Dictionary with CD, New Delhi, 2011
2. Cambridge Learners Dictionary with Cd, CUP, New Delhi, 2009

Reference Books:

1. J. D. O'Connor, *Better English Pronunciation*, CUP, London, 2006.
2. Patnait, *Group Discussion and Interview Skills*, CUP, New Delhi, 2011.

2.2.9 IT-AU-118 Environmental Science

L	-	T	-	P	Cr.
2	-	0	-	0	-

Course Code	:	$IT - AU - 118$
Course Name	:	*Environmental Science*
Contact Hours per Week	:	*Lectures-2, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 50*

Course Objectives: The objectives are to:

1. Understand the concept of the environment, including its scope, components, and interactions between abiotic and biotic factors.
2. Explore the characteristics, structure, and function of various ecosystems, such as forests, grasslands, deserts, and aquatic ecosystems, and comprehend ecological pyramids, energy flow, and nutrient cycling.
3. Recognize the value of biodiversity, the factors leading to biodiversity loss, and the importance of biodiversity conservation.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing environmental problems and issues, including the greenhouse effect, ozone depletion, acid rain, and the impact of renewable and non-renewable resources.
2. Evaluate environmental pollution sources and effects, including air, water, soil, radioactive, and noise pollution, and understand the impact of industrial pollutants on the environment and human health.
3. Develop knowledge of environmental pollution management strategies, including biotransformation, bioremediation, wastewater treatment, and waste management, and understand the legal framework for environmental protection, including the Environment Protection Act.

Unit I

Environment, Ecosystems and Biodiversity: Concept of environment: Scope of Environmental Science, components of environment and their interactions; abiotic and biotic factors; Ecosystems: characteristic feature and structure and function of forest, grassland, desert and aquatic ecosystem (Ponds, lakes, rivers, oceans); Ecological pyramid; energy flow and nutrient cycling; Biodiversity: value of biodiversity; loss and conservation of biodiversity.

Unit II

Environmental problems and Management: Environmental problems and issues: greenhouse effect, ozone depletion, acid rain; Environmental pollution: sources and effect of air, water, soil, radioactive and noise pollution; Industrial pollutants and their impact on environment and human health; toxic chemicals: heavy metals and pesticides; biotransformation and bioremediation; Aerobic and anaerobic treatment of waste water; waste management.

Text Books:

1. W. P. Cunningham and W.B. Saigo, *Environmental Science*, McGraw Hill Publication, 1999.
2. E. P. Odum and G. W. Barrett, *Fundamentals of Ecology*, Singapore, Thomson Asia Pvt. Ltd., 2005.
3. E. Bacci, *Contaminants in the Environment*, CRC Press, 1994.

Reference Books:

1. N. J. Sell, *Industrial Pollution Control: Issues and Techniques*, Wiley Publication, 1992.
2. V. Rao, *Textbook of Environmental Engineering*, PHI, 2003.

2.3 Third Semester

L	-	T	-	P	Cr.
3	-	1	-	0	4

2.3.1 IT-HSM-201 Engineering Economics and Management

Course Code	:	$IT-HSM-201$
Course Name	:	*Engineering Economics & Management*
Contact Hours per Week	:	*Lectures-3, Tutorial-1*.
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five*.
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the fundamental concepts of economics and its importance in engineering and management.
2. Explore microeconomics principles such as demand, supply, utility, costing, revenue, and the theory of production.
3. Gain knowledge of macroeconomics concepts including market classification, pricing methods, capital budgeting, inflation, and the role of financial institutions.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing economic principles such as demand, supply, and costing, and their application in engineering and management decision-making.
2. Evaluate pricing methods, capital budgeting techniques, and inventory control strategies to optimize business operations.
3. Develop an understanding of management functions, schools of management thought, and the contributions of Indian management thinkers.

Unit I
Fundamentals of Economics: Definitions of Economics; Importance of Economics in Engineering, Micro and Macro Economics; *Demand*- Law of Demand, Elasticity of Demand, *Utility*- Law of Diminishing, Marginal Utility, exceptions. Law of supply. *Costing*- Total cost, Variable cost, Marginal cost, Average cost, Sunk cost, Opportunity cost, *Revenue*- Total revenue, Marginal Revenue, Break-even analysis. Theory of Production- Factors of Production.

Unit II
Market classification, Pricing methods and strategies, Capital budgeting, make or buy decisions, Value Analysis vs. Value Engineering, Inventory control, inflation and deflation, Reserve Bank of India vs Commercial Banks. Preparation and Evaluation of projects.

Unit III
Basic Concepts of Management: Functions, Scope and Significance. *Schools of Management Thought*: Classical Perspective- Scientific Management, Administrative Management, Bureaucratic Management; Behavioral Perspective; Systems and Contingency Approaches of Management. Contribution of India Management Thinkers.

Unit IV
Fundamentals of Planning, Organising, Staffing, Directing and Leadership, Controlling and Coordinating. Case study of management Practices of Indian/International businessmen: Dhirubhai Ambani, Narayan Murthy, Azim Premji, Ratan Tata, Steve Jobs, Bill Gates. Mumbai Dabbawala story, Flipkart, Kingfisher Airlines, Sahara India pariwar

Text Books:

1. R. Panneerselvam, *Engineering Economics*, 2nd ed., PHI, 2014.
2. C. S. Park, *Fundamentals of Engineering Economics*, 3rd ed., Pearson, 2013.
3. J. A. L. Waddell, *Engineering Economics*, Hard Press Publishing, 2014

Reference Books:

1. R. Rodriguez, *Engineering Economics*, Kindle Edition, 2022.
2. Robbins, P. Stephen, D. Cenzo, A. David, Coulter, Mary, *Fundamentals of Management*, Pearson, 2016
3. A. Sachdeva & P. Kumar, *Fundamentals of Management*, S Chand Publishing, 2012.

2.3.2 IT-PC-203 Discrete Mathematics

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-203$
Course Name	:	*Discrete Mathematics*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand fundamental mathematical tools and concepts essential for computer science and engineering domains.
2. Develop a solid understanding of discrete structures: sets, relations, functions, graphs, trees, and algebraic structures.
3. Explore applications of discrete structures in algorithm design, data structures, computer networks, cryptography, etc.

Course Outcomes: After completion of the course, students will be able to:

1. Gain proficiency in analyzing and solving problems using discrete structures like sets, relations, functions, graphs, trees, and algebraic structures.
2. Apply discrete mathematics knowledge in algorithm design, data structures, computer networks, and cryptography.
3. Enhance the ability to conceptualize and model real-world problems using discrete mathematical frameworks.

Unit I
Introduction : Introduction to Discrete mathematics and it's various applications.
Logic: propositional logic (formulae, truth tables, proof systems), predicate logic (formulae, interpretations). Relations: Types of relations; various representations of relations, Different types of relations and Partial Ordering, Hasse diagram.
Functions: Functions; mappings; injection, surjections and bijection; composition of functions; inverse function.

Unit II
Combinatorics: permutation, combination, summations, partitions. Introduction to recurrence relation and generating function.
Graph Theory: Definition of a graph, graph terminologies, different types of graph , sub graphs, isomorphic and homeomorphic graphs, complete graphs, bipartite graphs, trees, spanning tree, graph coloring.

Unit III
Algebraic Structures: semigroup, monoid, groups, group homomorphism, rings, ring homomorphism, integral domains, fields. The application of Group Codes.

Text Books:

1. Lipschutz, Seymour and M. Lipson, *Schaum's Outline of Discrete Mathematics*, 4th ed. New York: McGraw-Hill Education, 2021.
2. B. Ram, *Discrete Mathematics*, Pearson, 2011.
3. N. Deo, *Graph Theory with Applications to Engineering and Computer Science*, Prentice Hall of India, 1974.

Reference Books:

1. J. P. Tremblay and R. P. Manohar, *Discrete Mathematics with Applications to Computer Science*, Tata McGraw-Hill, 2001.
2. C. L. Liu, *Elements of Discrete Mathematics*, 2nd Ed., Tata McGraw-Hill, 2000.
3. R. L. Graham, D. E. Knuth, and O. Patashnik, *Concrete Mathematics*, 2nd Ed., Addison-Wesley, 1994.

2.3.3 IT-BS-205 Statistics and Random Processes

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$ES-204$
Course Name	:	*Statistics and Random Processes*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the basic of probability theory.
2. Identify different distribution functions and their relevance.
3. To understand Stochastic Processes

Course Outcomes: After completion of the course, students will be able to:

1. Apply the concepts of probability theory to different problems.
2. Analyse various Stochastic processes and used use them for process characterization.

Unit I
Introduction to probability: Events, Set, set operations, classical and relative frequency based definitions of probability, axiomatic definition of probability, conditional probabilities, independence, total probability, Baye's rules and applications, Repeated trails. *Random variables*: Continuous and discrete random variables, cumulative distribution function (cdf), probability mass function(pmf), probability density functions(pdf) and properties.
Some special distributions: Binomial and Poisson discrete distributions, Uniform, exponential, Gaussian and Raleigh continuous distributions.

Unit II
Expected value of a random variable(s), mean, variances and moments of random variables. Function of single random variable. Moment generating and characteristic functions and their applications. Chebyshev Inequality. Orthogonal random variables.
Two dimensional random variables: joint distribution and density functions, marginal probability distribution, conditional probability distribution, independence. Functions of two random variables. Multivariate random variables, covariance and correlations, independence. Multivariate Gaussians distributions, vector- space representation of random variables. Inner product, Schwarz inequality.

Unit III
Sequence of random variables: almost sure and mean square convergence, convergence in probability and distribution, law of large numbers, central limit theorem.
Random Proccess: Discrete and continuous time processes, probabilistic description of random process, mean, auto correlation and auto covariance functions. *Stationarity*: strict sense stationary (SSS), wide sense stationary (WSS) processes, auto correlation functions of a WSS process and its properties, Cross correlation functions. Power spectral densities and properties. Gaussian process, Poison process and Markov processes.

Text Books:

1. A. Papoulis and S. U. Pillai, *Probability, Random variables and Stochastic process*, 4 ed. Mc Graw Hill, 2002.
2. A. L. Gracia. *Probability and Random Processes with Applications to Signal Processing*, 3rd ed. Pearson Education, 2008.

Reference Books:

1. P. Z. Pebbles, *Probability, random variables and random signals principles*, 4th ed. Mc Graw Hill, 2000.
2. T, Veerarajan, *Probability, statistics and random processes*, 2nd ed. Mc Graw Hill, 2003.

2.3.4 IT-PC-207 Data Structure and Algorithm

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-207$
Course Name	:	*Data Structure and Algorithm*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Allow to assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. Choose the appropriate data structure and algorithm design method for a specified application and to solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the Basic concept of Linear Data Structures.
2. Understand the Basic concept of Non-linear Data Structures.
3. Explore with applications of different data structure.

Unit I
Introduction: Types of Data Structures, List- array and linked list representation, insertion, deletion and searching of elements in a list, circular linked list- insertion, deletion, and search operation, Stack- array and linked list representation, operations on stacks, its application in prefix, postfix and infix expression, Queue- array and linked list representation, insertion and deletion operations in queue, and Circular queue.

Unit II
Non-linear Data Structure: Introduction to Tree, Representation of Tree, Binary Trees, Tree traversals, *Binary Search Tree*: Introduction and representation, Searching, insertion and deletion operation in a Binary Search Tree. *AVL Tree*: representation, searching, inserting and deleting in AVL tree

Unit III
Graphs: Introduction to graph theory, array and linked list representations, Breadth-first and Depth-first Search. *Spanning tree*: Introduction, Kruskal's algorithm, *Hashing*: Hashing functions, searching using hash technique, Collision avoidance techniques- linear probing, separate chaining.

Text Books:

1. S. Lipschutz, *Data Structures*, 4th ed. TMH, 2006.
2. V. A. Alfred, J. E. Hopperoft, U Jeffrey, *Data Structures and Algorithms*, Addison Wesley, 1983.
3. H. Ellis and S. Sahni, *Fundamentals of Data Structures*, Galgotia Pub., 2008.

Reference Books:

1. Y. Langsum, M. J. Augenstein, A. M. Tenenbaum, *Data Structures using C and C++*, 2nd ed., PHI, 1998.
2. Horowitz and Sahni, *Fundamentals of Computer Algorithms*, Galgotia Pub. 2001.

2.3.5 IT-PC-209 Computer Graphics and Multimedia

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-209$
Course Name	:	*Computer Graphics and Multimedia*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand computer graphics fundamentals, including image representation and interaction.
2. Learn scan conversion techniques for geometric primitives.
3. Master 2D and 3D transformation methods, including translation, rotation, scaling, and reflection.

Course Outcomes: After completion of the course, students will be able to:

1. Create and manipulate images using graphics algorithms.
2. Apply 2D and 3D transformations to objects.
3. Understand multimedia principles and their applications.

Unit I
Introduction to computer graphics & graphics systems: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; *Raster scan display Scan conversion*: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; Scan line polygon fill algorithm, Boundary fill algorithm, Flood fill algorithm.

Unit II
2D transformation & viewing: Basic transformations: translation , rotation, scaling, reflection; Matrix representations and homogeneous coordinates; Viewing pipeline, Window to viewport coordinate transformation, clipping operations, point clipping , line clipping , Polygon Clipping; *3D transformation & viewing*: 3D transformations: translation, rotation, scaling & other transformations, Rotation about an arbitrary axis in space, reflection through an arbitrary plane; viewport clipping, 3D viewing.

Unit III
Introduction to Multimedia: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications. *Text*: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption. *Audio*: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI. *Image*: Formats, Image Color Scheme and Model, *Digital Video*: Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals. *Synchronization*: Temporal relationships, synchronization accuracy specification factors, quality of service

Text Books:

1. D. Hearn, M. Pauline Baker, *Computer Graphics C version*, 4th Ed. Pearson education, 2011.
2. Z. Xiang, R. Plastock, *Schaum's outlines Computer Graphics* 2nd Ed. McGraw-Hill Education, 2000.
3. R. Parekh, *Principles of Multimedia*, 2nd Ed. McGraw-Hill Education, 2017.

Reference Books:

1. J. D. Foley, A. van Dam, S. K. Feiner, F. Hughes John, *Computer Graphics principles*, 3rd Ed. Pearson Education, 2011.
2. W. M. Newman, R. F. Sproull, *Principles of Interactive computer Graphics*, McGraw Hill Education, 2001.
3. R. Steinmetz, K. Nahrstedt, *Multimedia: Computing Communications and Applications*, 1st Ed. McGraw Hill Education, 2002.

2.3.6 IT-PC-LC-211 Data Structure Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-211$
Course Name	:	*Data Structure Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Design and analyze the time and space efficiency of the data structure
2. Identity the appropriate data structure for a given problem
3. Have practical knowledge of the applications of data structures

Course Outcomes: After completion of the course, students will be able to:

1. Analyze and implementation of sorting Techniques.
2. Analyze and implementation of Searching Techniques.
3. Design and Implement different data structure using array and linked list.

List of Programs:

1. Implementation of Singly Linked List and perform insertion, deletion, display and search operation on it.
2. Implementation of Doubly Linked List and perform insertion, deletion, display and search operation on it.
3. Implementation of Circular Linked List and perform insertion, deletion, display and search operation on it.
4. Array implementation of Stack, Queue, and Circular queue data structures.
5. Linked List implementation of Stack, Queue and Circular queue data structures.
6. Implementation on conversion of infix expression to prefix and postfix using Stack,
7. Implementation on evaluation of expression using Stack.
8. Linked list representation of binary tree and perform insertion, deletion operation on it.
9. Implementation of tree traversals techniques (in order, preorder and post order traversals).
10. Implementation of binary search tree and perform searching on it.
11. Implementation of Breath first search in a graph.
12. Implementation of Depth first search in a graph.
13. Implementation of Hashing using chaining and linear probing technique.

Text Books:

1. S. Lipschutz, *Data Structures*, 4th ed., TMH, 2006.
2. T. H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, *Introduction to Algorithms*, MIT Press, 2009.

Text Books:

1. E. Horowitz and S. Sahni, *Fundamentals of Data Structures in C*, University Press, 2008.
2. R. Sedgewick, *Algorithms in C Parts 1-4: Fundamentals, Data Structures, Sorting, Searching*, Pearson, 1997.
3. R. Sedgewick, *Algorithms in C Part 5: Graph Algorithms*, Pearson, 2001.

2.3.7 IT-PC-LC-213 Computer Graphics and Multimedia Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-213$
Course Name	:	*Computer Graphics and Multimedia Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand fundamental graphics algorithms for drawing 2D primitives using C and OpenGL.
2. Implement translation, rotation, and reflection of 2D primitives using C and OpenGL.
3. Explore 3D transformations such as translation, rotation, scaling, and projections using OpenGL.

Course Outcomes: After completion of the course, students will be able to:

1. Implement DDA and Bresenham's algorithms for drawing lines, circles, and ellipses.
2. Apply translation, rotation, and reflection transformations to 2D primitives.
3. Manipulate and visualize objects in 3D space using 3D transformations and projections.

List of Programs:

Experiments using C/OpenGL/Java

1. Implementation of Algorithms for drawing 2D Primitives - Line (DDA, Bresenham) – all slopes
2. Circle Generation (Midpoint, Bresenham),
3. Ellipse Generation (Midpoint)
4. 2D Geometric transformations – Translation of a Line,
5. Rotation, Reflection of a Line.

Experiments using OpenGL

1. 3D Transformations - Translation, Rotation, Scaling
2. 3D Projections – Parallel, Perspective
3. Creating 3D Scenes

Experiments using Adobe Flash, Photoshop

1. Image Editing and Manipulation - Basic Operations on image using any image editing software, Creating gif animated images, Image optimization
2. 2D Animation – To create Interactive animation using any authoring tool (Motion Tween, Shape Tween, Guided Motion Tween, Digital Clock, Analog Clock, Masking)

Text Books:

1. D. Hearn and M. Pauline Baker, W. Carithers, *Computer Graphics with OpenGL* , 3rd Ed. Pearson education, 2013.
2. R. Steinmetz and K. Nahrstedt, *Multimedia: Computing Communications and Applications*, 1st Ed. Mc-Graw Hill Education, 2002.

Reference Books:

1. M. K. Pakhira, *Computer Graphics, Multimedia And Animation*, 2nd Ed. PHI, 2010.
2. A. Michael, *Animating with Flash 8: Creative Animation Technique*, 1st Ed. Focal Press, 2006.

2.4 Fourth Semester

L	-	T	-	P	Cr.
3	-	0	-	0	3

2.4.1 IT-BS-202 Biology for Engineers

Course Code	:	$IT-BS-202$
Course Name	:	*Biology for Engineers*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objective: The objectives are to:

1. Understand the structure and function of prokaryotic and eukaryotic cells, including cellular organelles and their organization.
2. Explore the molecular biology of cells, including the structure of macromolecules such as polysaccharides, polypeptides, and polynucleotides.
3. Gain knowledge of cell cycle regulation, cell division processes such as mitosis and meiosis, and the mechanisms of DNA replication, transcription, and translation.

Course Outcome: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing the structure and function of cellular organelles and understanding their roles in cellular processes.
2. Evaluate the conformational properties of macromolecules and their significance in biological systems.
3. Apply knowledge of molecular biology principles, including DNA replication, transcription, translation, and gene expression regulation, to solve biological problems.

Unit I
Structure of prokaryotic and eukaryotic cells; Bacterial chromosomes and plasmids; Cellular organelles: cell wall, plasma membrane, mitochondria, nucleus, Golgi bodies and endoplasmic reticulum; and other organelles and their organization; Cell cycle and cell division: Mitosis and Meiosis.

Unit II
Types of macromolecules in biological systems; Conformational properties of polysaccharides and polypeptides; Secondary and tertiary structural features of proteins. Conformational properties of polynucleotides and Structure of DNA; Sequence component of eukaryotic genome; DNA replication; Mechanism of transcription and post-transcriptional modifications of RNAs; Features of genetic code and translation; Concept of regulation of gene expression: Prokaryotic gene expression with reference to inducible and repressible operon.

Unit III
Milestones in Genetic Engineering; Molecular tools and their applications in development of transgenic organism; Central dogma of molecular biology; cDNA; Gene Therapy; Introduction to Bioinformatics and its applications; Human genome project and role of computational biology; Sequence analysis: Paired, multiple and dotplot methods of alignment; Concept of database; Tools/algorithms: Basic Local Alignment Search Tool, FASTA; Biotechnology and engineering; Concept of safety and ethics associated with gene manipulation.

Text Books:

1. B. Albert et al., *Molecular Biology of Cell*, 3rd ed., New York: Garland Science; 2002.
2. H. F. Lodish, *Molecular Cell Biology*, W.H. Freeman publication, 2000.
3. B. Lewin, *Gene VIII*, Oxford University Press, 2003.
4. D. M. Grover and B. D. Hames, *DNA Cloning: a practical approach*, IRL Press, Oxford 1995

Reference Books:

1. P. K. Gupta, *Elements of Biotechnology*, Rastogi Publications, Meerut, 2020.
2. R. C. Dubey. *A Text Book of Biotechnology*, S. Chand Publishing, 1993.
3. W. J. Thieman, M. A. Palladino, *Introduction to Biotechnology*, Pearson, 2013.

2.4.2 IT-ES-204 Digital Electronics

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$ES-204$
Course Name	:	*Digital Electronics*
Contact Hours per Week	:	*Lectures-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Learn the fundamentals of binary, octal, and hexadecimal number systems.
2. Learn about logic gates, including AND, OR, NOT, NAND, and NOR gates.
3. Gain knowledge about various types of flip-flops including SR, JK, D, and T flip-flops.

Course Outcomes: After completion of the course, students will be able to:

1. Perform Number System Conversions.
2. Gain proficiency in Boolean Algebra and Simplification.
3. Understand of Flip-Flops and Registers.

Unit I
Number Systems and Codes: Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, BCD, Error detection codes-Parity method.
Signed numbers- representation, addition and subtraction,Fixed point and floating-point representation. Logic gates, Universal gates, TTL and CMOS logic families-Internal diagram of TTL NAND gate and CMOS NOR gate. Comparison of CMOS and TTL performance.

Unit II
Boolean Laws and theorems, Sum of Products method, Product of Sum method – K map representation and simplification(up to four variables) - Pairs, Quads, Octets, Don't care conditions.
Combinational circuits: Adders -Full adder and half adder, Subtractors- halfsubtractor and full subtractor, 4 bit parallel binary adder/subtractor, Carry Look ahead adders.

Unit III
Comparators, Parity generators and checkers, Encoders, Decoders, , BCD to seven segment decoder, Code converters, Multiplexers, Demultiplexers, Architecture of Arithmetic Logic Units.

Unit IV
Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Preset and clear inputs, Conversion of flip-flops. Registers -SISO, SIPO, PISO, PIPO.
Up/Down Counters: Asynchronous Counters – Modulus of a counter – Mod-N counters Ring counter, Johnson Counter

Text Books:

1. M. M. Mano, *Logic and Computer Design Fundamentals*, 4th ed., Pearson Education, 2017.
2. T. L. Floyd, *Digital Fundamentals*, 9th ed., Pearson International Publications, 2000.
3. Malvino and Leach, *Electronics Principles*, 3rd ed., Mc. Graw Hill, 2000.

Reference Books:

1. R. L. Tokheim, *Digital Electronics: Principles and Applications*, Tata McGraw-Hill Education, 2013.
2. I. J. Nagrath, *Electronics Analog and Digital*, PHI Learning Pvt. Ltd., 2013.
3. K. Meena, *Principles of Digital Electronics*, 4th ed., PHI Learning Pvt. Ltd., 2013.

2.4.3 IT-PC-206 Theory of Computation

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-206$
Course Name	:	*Theory of Computation*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the notion of computability and intractability
2. Understand the abstraction of computation as set membership problem.
3. Familiarize the different computational models delineating the capabilities and limitations to solve set membership problems.

Course Outcomes: After completion of the course, students will be able to:

1. Design appropriate finite automata and grammar for different classes of languages
2. Familiarize with the concept of language recognition and language generation and their equivalence.

Unit I
Basic concepts: alphabets, languages, and grammars. *Regular Languages*: regular expressions. regular grammars, closure properties, Pumping lemma, decidable properties of regular languages. *Deterministic and nondeterministic finite automata*: equivalence of DFAs and NFAs, DFA state minimization: Myhill-Nerode relations and theorem

Unit II
Context free languages: context free grammars (CFGs): derivations, derivation trees, ambiguous grammars, inherently ambiguous languages, *normal forms of CFGs*: Chomsky Normal Form and Greibach Normal Form. *Pushdown automata (PDAs)*: deterministic and nondeterministic PDAs (DPDAs and NPDAs), deterministic CFLs, closure properties of CFLs, Pumping lemma and Ogden's Lemma, decidable properties of CFLs.

Unit III
Turing machines: Church Turing thesis, techniques for turing machine construction, Generalized and restricted versions equivalent to the basic model, Universal Turing machine, recursively enumerable sets and recursive sets. Notion of tractability/feasibility. The classes NP and co-NP, their importance.

Text Books:

1. D. I. A. Cohen, *Introduction to Computer Theory*, 2nd Ed. Wiley, 1996.
2. J. E. Hopcroft, R. Motwani and J. D. Ullman, *Introduction to Automata Theory, Languages and Computation*, 2nd Ed. Pearson Education, 2000.

Reference Books:

1. M. Sipser, *Introduction to the Theory of Computation*, Thomson, 2004.
2. H. R. Lewis and C. H. Papadimitriou, *Elements of the Theory of Computation*, Pearson Education Asia, 2001.
3. D. C. Kozen, *Automata and Computability*, Springer-Verlag, 1997.

2.4.4 IT-PC-208 Relational Database Management System

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-208$
Course Name	:	*Relational Database Management System*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand fundamental database concepts, including file systems versus DBMS, levels of abstraction, and ER modeling.
2. Learn the relational model, covering relations, integrity constraints, relational algebra, and calculus.
3. Learn schema refinement techniques such as functional dependencies and normalization up to BCNF to address data redundancy.
4. Develop proficiency in writing and executing SQL queries, including nested queries, aggregate queries, and views.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate a clear understanding of database principles, distinguishing between file systems and DBMS.
2. Define relations, enforce integrity constraints, and perform operations using relational algebra and calculus.
3. Normalize database schemas up to BCNF to minimize data redundancy.
4. Write SQL queries proficiently to retrieve, manipulate, and aggregate data from relational databases.

Unit I
Introduction: Overview, File systems Vs. DBMS, Levels of abstraction, ER Modeling. Relational Model: Overview, Relations and Integrity Constraints, Relational Algebra and Calculus. Schema Refinement: Problem of data redundancy, Functional dependencies, Closure, Attribute Closure, Normal Forms: 1NF-3NF, BCNF; Decompositions.

Unit II
SQL: Basic SQL Query, Nested Queries, Aggregate queries, Views. Query optimization and evaluation: Steps in query processing, Selection operation, Join operation, Query optimization, Query Evaluation.

Unit III
Concurrency control and recovery: Concepts of transactions, ACID, Concurrent Execution, Schedules, Serializability, Lock based concurrency control: Simple, Two phase and Graph based. Crash recovery: Introduction to crash recovery, Log based recovery, Check pointing.

Text Books:

1. A. Silberschatz, H. F. Korth, S. Sudarshan, *Database System Concepts*, 7th Ed. McGraw Hill Education, 2024.
2. R. Ramakhrishnan, J. Gehrke, *Database Management Systems*, 3rd Ed. McGraw Hill Higher Education, 2002.

Reference Books:

1. B. C. Desai, *An Introduction to Database System*, 11th Ed. Galgotia Publication, 1998.
2. R. Elmasri and S. B. Navathe, *Fundamental of Database Systems*, 7th Ed. Pearson, 2017.

2.4.5 IT-PC-210 Object Oriented Programming

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-210$
Course Name	:	*Object Oriented Programming*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the basics of Object-Oriented Programming (OOP)
2. Understand different types of inheritance including single, multiple, multilevel, and hierarchical inheritance.
3. Understand the concept of polymorphism templates including class templates and function templates.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate a clear understanding of OOP principles including Abstraction, Encapsulation, Inheritance, and Polymorphism.
2. Define and implementing derived classes with appropriate inheritance types, address issues related to inheritance, such as ambiguity in multiple inheritance.
3. Implement class templates and function templates for generic programming.

Unit I
Introduction: Basic concepts of OOP (Abstraction, Encapsulation, Inheritance, Polymorphism), *Procedural programming vs OOP Objects and Classes*: Concepts of class and objects, member access operators, access functions (private and public) constructors and destructor, static members, arrays of objects, returning objects from functions, Friend functions and classes

Unit II
Inheritance: Types of inheritance, defining derived class, public, private and protected inheritance, accessing base class members, ambiguity in multiple inheritance, virtual base classes, abstract classes, derived class constructor with arguments.

Unit III
Polymorphism: Compile time polymorphism-operator overloading, function overloading, Run-time polymorphism, Virtual function, and pure virtual function.
Templates: instantiation, class template, function templates, function template overloading, Exception handling: Error handling, grouping of exceptions, catching exceptions, catch all, re-throw.

Text Books:

1. E. Balaguruswamy, *Object oriented programming with C++*, TMH, 2013.
2. H. Schildt, *C++: The Complete Reference*, 4th Ed. TMH, 2003.

Reference Books:

1. B. Stroustrup, *The C++ Programming Language*, Addison Wesley, 2002.
2. H. Schildt, *C++: The Complete Reference*, 4th ed. McGraw-Hill Education (India), 2017.
3. D. Jana, *C++ and Object Oriented Programming – Jana*, 1st ed. PHI Learning, 2014.

2.4.6 IT-PC-LC-212 Relational Database Management System Lab

L	T	P	Cr.
0	0	4	2

Course Code	:	$IT-PC-LC-212$
Course Name	:	*Relational Database Management System Lab.*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Develop proficiency in creating, altering, and dropping tables with integrity constraints.
2. Retrieve and modify data effectively from a database.
3. To develop competency in using both implicit and explicit cursors for efficient data handling.
4. Learn and apply exception handling techniques to manage errors and unexpected situations in database operations.

Course Outcomes: After completion of the course, students will be able to:

1. Independently design, create, and manage relational database structures with appropriate integrity constraints.
2. Perform complex data retrieval and modification tasks using SQL queries.
3. Develop and deploy stored procedures and functions for automating repetitive tasks and enhancing data manipulation capabilities.
4. Implement triggers to automate data validation, auditing, and other data manipulation tasks within the database environment.

List of programs:

1. Program for creating, altering and dropping tables with integrity constraints.
2. Program for retrieving and modifying data from a database.
3. Program for retrieving data from database using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING clause.
4. Program using of scalar and aggregate functions.
5. Program for retrieving data from a database using Equi, Non Equi, Outer and Self Join.
6. Program using subqueries.
7. Program use of views, indexes and sequences.
8. Program using of implicit & explicit cursors in data handling.
9. Program using exception handling.
10. Program using stored procedures & functions in data manipulation.
11. Program using trigger in data manipulation.

Text Books:

1. I. Bayross, *SQL, PL /SQL – The Programming Language of Oracle*, 4th Revised Ed. BPB Publications, 2009.
2. S. Feuerstein and B. Pribyl, *Oracle PL/SQL Programming*, Shroff/O'Reilly, 2014.

Reference Books:

1. K. Loney and G. Koch, *Oracle9i: The Complete Reference*, 1st Ed. McGraw-Hill Osborne Media, 2002.

2.4.7 IT-PC-LC-214 Object Oriented Programming Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-214$
Course Name	:	*Object Oriented Programming Lab.*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Implement the syntax and semantics of C++ programming language.
2. Learn programs illustrating the implementation of class, object, polymorphism, and inheritances in OOP.
3. Perform problem solving through debugging.

Course Outcomes: After completion of the course, students will be able to:

1. Differentiate structure oriented programming and object oriented programming.
2. Understand and apply various object oriented features.
3. Know concepts in operator overloading, function overloading polymorphism.
4. Reuse of code using inheritance and implement the concept of files, templates and exceptions.

List of programs:

1. Write a C++ program to define a class Complex and overload operators +, - , *, <<, >> for complex numbers.
2. Write a C++ program for a class Matrix and overload operators +, - , *, <<, >>.
3. Write a C++ program to define a class String and write a C++ program to overload + for concatenation, >= , <=, == for comparison of two strings.
4. Write a C++ program to differentiate between overloading and overriding a method in C++.
5. Write a C++ program to demonstrate the implementation of various forms of inheritance (Ex. Single Hierarchical, Multilevel inheritance etc.) in C++
6. Write a C++ program that illustrates the implementation of multiple inheritances in C++.
7. Write a C++ program to implement a basic two-dimensional Shape class from which objects such as rectangle, circle which can be derived.
8. Write a C++ program to demonstrate the use of static variable and static function.
9. Write a C++ program to implement insertion and deletion in Stack with exception handling and templates.
10. Write a C++ program to implement operations Queue insertion, deletion with exception handling and templates.

Text Books:

1. E. Balaguruswamy, *Object oriented programming with C++*, TMH, 2013.
2. H. Schildt, *C++: The Complete Reference*, 4th Ed. TMH, 2003.

Reference Books:

1. B. Stroustrup, “The C++ Programming Language”, Addison Wesley, 2002.
2. H. Schildt, *C++: The Complete Reference*, 4th ed. McGraw-Hill Education (India), 2017.
3. D. Jana, *C++ and Object Oriented Programming – Jana*, 1st ed. PHI Learning, 2014.

2.5 Fifth Semester

L	-	T	-	P	Cr.
3	-	1	-	0	4

2.5.1 IT-PC-301 Computer Networks

Course Code	:	$IT-PC-301$
Course Name	:	*Computer Networks*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the history and development of computer networks, Internet standards, and administration, as well as network architecture models such as ISO-OSI and TCP/IP.
2. Explore various network performance measurement techniques, data encoding methods, error detection, and reliable data transmission protocols.
3. Gain knowledge of multiple access protocols, internetworking concepts, basic Internet protocols, routing algorithms, and end-to-end protocols for communication.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing computer network architectures, performance measurement techniques, and data transmission protocols.
2. Evaluate internetworking concepts, including switching, bridging, and routing algorithms, and understand the functions of basic Internet protocols such as IPv4, IPv6, ARP, and DHCP.
3. Apply knowledge of end-to-end protocols like TCP, UDP, RTP, and RPC in designing and implementing network communication solutions.

Unit I
Introduction: History and development of computer networks, Internet standards and administration, Network architecture models-ISO-OSI and TCP/IP, Network performance measurement, Data encoding techniques, Framing, Error detection, Reliable data transmission, Multiple access protocols- ALOHA, CSMA/CD, FDMA, TDMA, CDMA.

Unit II
Internetworking: Switching and bridging, Basic Internet Protocols: IPv4, IPv6, ARP, DHCP, ICMP, Concepts of Subnetting, Supernetting, Routing algorithms: Distance vector, Link state, Hierarchical routing, Classless addressing, Network Address Translation (NAT).

Unit III
End-to-end protocols: Inter-process communication, Transmission Control Protocol (TCP)- Connection establishment & Release, Flow control and buffering, transmission policy, User Datagram protocol (UDP), Real-time Transport Protocol (RTP), Remote Procedure Call (RPC) Congestion control: Congestion control in IP and TCP, Congestion-avoidance mechanisms, Socket Programming basics, socket functions.

Unit IV
Data representation: Presentation formatting, multimedia data. *Applications*: Traditional applications- E-mail, World Wide Web (WWW), Multimedia Applications- Session control and call control (SDP, SIP, H.323), Resource allocation for multimedia applications, Infrastructure services- Domain Name Service (DNS), Simple Network Management Protocol (SNMP), Firewall.

Text Books:

1. L. L. Peterson and B. S. Davie, *Computer Networks- A Systems Approach*, 6th ed., The Morgan Kaufmann Series in Networking, 2021.
2. D. E. Comer, *Internetworking with TCP/IP- Principles, Protocols, and Architecture*, 5th ed., PHI, 2006.

Reference Books:

1. Forouzan, *Data Communications and Networking*, 6th ed., Mcgraw Hill, 2022.
2. J. F. Kurose and K. W. Ross, *Computer Networking: A Top-Down Approach*, 8th ed., Pearson Education, 2022.

2.5.2 IT-PC-303 Computer Organization and Architecture

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-303$
Course Name	:	*Computer Organization and Architecture*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Familiarize with the fundamental components and interconnections in computer systems
2. Understand Instruction Set Architecture (ISA), addressing modes, instruction format, and control unit design.
3. Learn memory organization, I/O interfacing, and parallel processing concepts.

Course Outcomes: After completion of the course, students will be able to:

1. Recognize the components and their respective functions within a computer system.
2. Understand the design of instruction and analyze and evaluate the performance of processors.
3. Gain knowledge of memory organization, I/O interfacing, and the fundamentals of parallel processing.

Unit I
Simple Linear Regression and Correlation: Introduction to Linear Regression, The Simple Linear Regression Model, Least Squares and the Fitted Model, Properties of the Least Squares Estimators, Inferences Concerning the Regression Coefficients, Prediction, Simple Linear Regression Case Study.
Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence.

Unit II
Instruction Set Architecture (ISA): Instruction set, instruction format, addressing modes, register transfer language and micro operation, design of control unit: microprogrammed and hardwired control unit, instruction pipelining, pipelining hazards

Unit III
Memory and I/O access: memory organization, static and dynamic memory, memory hierarchy, Cache memory, Main memory, Virtual memory, Memory maps, I/O interfacing, Programmed I/O, Concept of handshaking, Polled and Interrupt driven I/O, DMA data transfer, Introduction to parallel Processing.

Text Books:

1. M. M. Mano, *Computer System Architecture*, 3rd Ed., Pearson Education, 2017.
2. W. Stallings, *Computer Organization & Architecture*, 8th Ed., Pearson Education, 2009.

Reference Books:

1. Hennessey and Patterson, *Computer Architecture: A quantitative Approach*, 5th Ed., Morgan Kaufman Publication, 2012.
2. C. Hamacher, *Computer Organization*, 5th Ed., Tata McGraw Hill, 2011.

2.5.3 IT-PC-305 Operating System

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-305$
Course Name	:	*Operating System*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the fundamental concepts and components of operating systems.
2. Explore the functionalities and services provided by the operating systems.
3. Learn about interprocess communication and synchronization and deadlock.
4. Understand file system organization, access methods, file allocation methods and free space management.

Course Outcomes: After completion of the course, students will be able to:

1. Develop proficiency in understanding the structure and functionality of modern operating systems.
2. Develop competence in process management, including process creation, scheduling, and synchronization.
3. Understand of memory management techniques such as virtual memory, paging and segmentation.
4. Understand of the concept of deadlock and prevention, detection and avoidance of deadlock.

Unit I
Introduction: Objectives and functions of OS. *Process description and control*: Process states, Process control block, Process and threads. *Uniprocessor scheduling*: Types of CPU scheduling, CPU Scheduling algorithms.

Unit II
Concurrency: Principles of concurrency, mutual exclusion, Software and Hardware approaches, Semaphores, readers/writers problem, Principles of deadlock, Deadlock prevention, Detection and avoidance, Dining philosopher's problem.

Unit III
Memory Management: Background, Contiguous memory allocation, paging, structure of page table, Segmentation, Virtual memory, Demand paging, Page replacement algorithms (FIFO, LRU, Optimal page replacement), Thrashing. *File system*: File concept, File attributes, File operations, File access methods, Access control. File allocation methods, free space management. *Case study*: Unix file system.

Text Books:

1. A. Silbershatz, P.B. Galvin and Gagne, *Operating System Concepts*, 10th Ed., Wiley, 2019.
2. M. J. Bach, *The design of the UNIX operating system*, Eastern Economy Edition, Prentice Hall of India vt. Ltd., 2004.

Reference Books:

1. A. S. Tanenbaum, *Operating System Design and Implementation*, 3rd Ed., Practice Hall of India, 2004.
2. W. Stalling, *Operating Systems: Internals and Design Principles*, 5th Ed., Prentice Hall of India, 2007.
3. H. N. Dietel, *An Introduction to Operating Systems*, Addison Wesley, 1990.

2.5.4 IT-PC-307 Compiler Design

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PC-307$
Course Name	:	*Compiler Design*
Contact Hours per Week	:	*(Three) Hours.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the basic theory underlying the different components and phases of a compiler like parsing, code generation etc.
2. Familiarize with the various tools that are used for building modern compilers.

Course Outcomes: After completion of the course, student will be able to:

1. Understand the Basic concept of Compiler .
2. Understand the details about different phases of compiler tasks.
3. Explore with design of a compiler.

Unit I
Overview of phases of a compiler, Languages and grammar, a simple one-pass compiler, incorporating symbol table, *Lexical analysis*: Finite automata, from a regular expression to an NFA, Lexical analyzer: Design of Lexical analyzer generator.

Unit II
Parsing: Top-down and Bottom-up parsers, shift-reduce parser, recursive descent parser, LL (1); LR(0), SLR, LALR parsers, Syntax-directed translation, parser generator, *Semantic Analysis*: Syntax-directed translation.

Unit III
Intermediate Code Generation: Intermediate languages, assignment statements. Code generation: Basic blocks, optimization of basic blocks. Flow-graphs; Register allocation, simple code generator; *Code optimization*: An introduction to the optimization techniques, sources of optimization.

Text Books:

1. A. V. Aho, R. Sethi, and J.D. Ullman, *Compiler Design*, Pearson Education, 2003.

Reference Books:

1. J. Tremblay and P. G. Sorrenson, *The Theory and Practice of Compiler Writing*, McGraw Hill, 1985.
2. S. Chattopadhyaya, *Compiler Design*, PHI, 2005.

2.5.5 IT-OE-3091 Data Science and Analytics

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PE-3091$
Course Name	:	*Data Science and Analytics*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objective: The objectives are to:

1. Understand the significance and applications of data science across industries.
2. Develop skills in data collection, cleaning, and preprocessing for effective analysis.
3. Gain proficiency in statistical analysis techniques and basic machine learning concepts for practical problem-solving.

Course Outcome: After completion of the course, students will be able to:

1. Apply data science principles to solve real-world problems across industries.
2. Get proficiency in collecting, cleaning, and preprocessing data for analysis.
3. Get competence in conducting statistical analysis and applying basic machine learning techniques to derive insights from data.

Unit I
Introduction to Data Science: Overview of data science and analytics, importance and applications in various industries. *Data Collection and Preprocessing*: Techniques for data collection, data cleaning, transformation, and preprocessing.

Unit II
Statistical Experiments and Significance Testing: Hypothesis Tests, Resampling, Statistical Significance and P-Values, t-Tests, Multiple Testing, Degrees of Freedom, ANOVA, Chi-Square Test, Multi-Arm Bandit Algorithm.

Unit III
Machine learning basics: modeling, overfitting and underfitting, correctness, the bias-variance tradeoff, curse of dimensionality, feature extraction and selection. *Machine Learning Fundamentals*: Introduction to machine learning, Supervised, unsupervised, and semi-supervised learning, model evaluation and validation techniques

Text Books:

1. A. C. Müller and S. Guido, *Introduction to Machine Learning with Python: A Guide for Data Scientists*,
2. V. Kotu and B. Deshpande, *Data Science Concepts and Practice*, 2nd ed., Morgan Kaufmann publication, 2022.

Reference Books:

1. S. Arora and L. Malik, *Data Science and Analytics with Python*, Universities Press, 2023.
2. Agbinya and I. Johnson, *Applied Data Analytics: Principles and Applications*, 1st ed., River Publishers, 2020.

2.5.6 IT-OE-3092 Natural Language Processing

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PE-3092$
Course Name	:	*Natural Language Processing*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Know the fundamental concepts and models of speech and language processing.
2. To familiarize students with various linguistic resources and tools used in natural language processing (NLP).
3. Understand key techniques and algorithms employed in NLP tasks.

Course Outcomes: After completion of the course, students will be able to:

1. Explain the significance of ambiguity in language processing and discuss its implications on understanding language.
2. Design and implement regular expressions and finite-state automata for pattern matching and recognition tasks.
3. Utilize morphological analysis techniques and finite-state transducers for processing natural language morphology.
4. Demonstrate proficiency in utilizing linguistic resources such as corpora, TreeBank, WordNet, and PropBank for language analysis and processing.

Unit I
Introduction: Knowledge in speech and language processing – Ambiguity – Models and Algorithms – Language, Thought and Understanding. Regular Expressions and automata: Regular expressions – Finite-State automata. Morphology and Finite-State Transducers.

Unit II
Linguistics resources: Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK. N-grams, smoothing, entropy, ME, SVM, CRF.

Unit III
Part of Speech tagging: Stochastic POS tagging. HMM, Transformation based tagging (TBL), Spoken language syntax; Grammars and human processing. *Parsing with Context-Free Grammars*: Parsing as search, The early algorithm, Finite-State parsing methods.
Semantics: Meaning representation, semantic analysis, lexical semantics. Applications of NLP, Spell-checking, Summarization, Sentiment Analysis and Opinions on the Web.

Text Books:

1. D. Jurafsky and J. H. Martin, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, 2nd Ed. Pearson Education India, 2013.
2. P. Goyal, S. Pandey, K. Jain, *Deep Learning for Natural Language Processing: Creating Neural Networks with Python*, Apress, 2018.

Reference Books:

1. A. Bharati, R. Sangal, V. Chaitanya, *Natural Language Processing: A Paninian Perspective*, Prentice Hall India Learning Private Limited, 2003.
2. T. Siddiqui, U. S. Tiwary, *Natural language processing and Information retrieval*, Oxford University Press, 2008.
3. D. Jurafsky and J.H. Martin, *Speech and Language Processing*, 2nd Ed. Pearson, 2008.

2.5.7 IT-OE-3093 Graph Theory and its Application

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PE-3093$
Course Name	:	*Graph Theory and its Application*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand fundamental concepts of graph theory including graphs, sub-graphs, adjacency matrices, and degree sequences.
2. Explore advanced topics in graph theory such as coloring, covering, partitioning, and directed graphs, including their applications.
3. Gain knowledge of graph algorithms and their applications in problem-solving and optimization in various domains.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing and constructing graphs, identifying regular graphs, and understanding adjacency and incidence matrices.
2. Apply graph coloring, covering, and partitioning techniques to solve problems such as the Konigsberg bridge problem, traveling salesman problem, and job sequencing problem.
3. Understand the applications of graphs in various fields including computer programming, electrical networks, coding theory, and test case generation.
4. Develop skills in implementing graph algorithms such as Warshall's algorithm, Bellman-Ford algorithm, and topological sorting to solve real-world problems efficiently.

Unit I
Introduction: Graphs, Sub-graphs, Regular graph, Adjacency and incidence matrices, Finite and infinite graph, Incidence and degree, Isolated vertex, Pendent vertex and null graph, Turan's theorem.

Unit II
Coloring, Covering and Partitioning: Chromatic number, Chromatic Partitioning, Chromatic Polynomial, Covering, Four colour conjecture, Five-colour theorem, Dirac Theorem, Brooks theorem, Vizing theorem.
Directed Graphs: Directed graph, Diagraph and binary relations, Directed Paths, Euler diagraphs, Acyclic digraphs, Topological sorting, Warshall's algorithm, Bellman-Ford algorithm, Ramsey theorems.

Unit III
Application of Graphs: Study of Konigsberg bridge problem, Travelling-salesman problem, Utilities problem, Electrical network problem, Seating problem, Use of graph in sequential switching networks, Graphs in coding theory, Graphs in computer programming, Flow graph notation, Test case generation using graphs, Job sequencing problem, Graph coloring in scheduling of examinations.

Text Books:

1. D. Narsingh, *Graph Theory with applications to Engineering and Computer Science*, Prentice Hall of India, 2007.
2. M. M. Parmenter, and G.E. Goodaire, *Discrete Mathematics with Graph Theory*, Prentice-Hall of India, 2007.

Reference Books:

1. Rosen, and H. Kenneth, *Discrete Mathematics and its Applications*, Tata Mcgraw-Hill, 2003.
2. J. A. Bondy and U. S. R. Murty, *Graph theory and Applications*, North Holland Publications, 1995.

2.5.8 IT-OE-3094 Game Theory

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-PE-3094$
Course Name	:	*Game Theory*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Familiarize the students with the fundamental aspects of Game Theory.
2. understand the possible advantage of moving first, the credibility of threats, the strategic importance of having a last encounter, and the mechanisms to keep cooperation alive.
3. Recognize strategic environments and use Game Theory to gain better understanding of interactions and outcomes within them.

Course Outcomes: After completion of the course, students will be able to:

1. Formulate different real-life situations as games and learn to predict the optimal strategies of the players.
2. Analyze the possible outcomes of situations ranging from card games and sports to strategic price fixing, negotiation, group cooperation.

Unit I
Strategic-form games, Dominance, Nash equilibrium, Existence: convex strategy sets, mixed extension; computation, Two player zero-sum games, Correlated rationalizability and iterated elimination of dominated strategies, Correlated equilibrium

Unit II
Bayesian games, types and Bayes-Nash equilibrium, First-price auction, Bilateral trading

Unit III
Repeated Games, infinitely repeated games, Nash Folk theorem, Subgame perfect equilibrium and perfect Folk theorem, One-shot deviation principle, Tacit collusion. Extensive form games: perfect information, Game trees and extensive forms, Reduced form and Nash equilibrium, Backward induction and subgame perfect equilibrium, Mixed and behavior strategies, Alternating offers bargaining, Extensive form games: incomplete information, Perfect Bayesian equilibrium, Sequential equilibrium

Text Books:

1. Osborne, *An Introduction to Game Theory*, Oxford University Press, 2014.
2. M. J. Osborne and A. Rubinstein, *A Course in Game Theory*, MIT Press, 1994.

Reference Books:

1. M. Maschler, E. Solan, and S. Zamir, *Game Theory*, Cambridge University Press, 2020.
2. M. Osborne, *An Introduction to Game Theory*, Oxford University Press, 2003.
3. v. Krishna, *Auction Theory*, Academic Press, 2009.

2.5.9 IT-PC-LC-311 Computer Network Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-311$
Course Name	:	*Computer Network Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Gain practical experience in implementing various data link layer framing techniques such as byte stuffing and bit stuffing.
2. Understand the operation of different Automatic Repeat reQuest (ARQ) protocols including Stop-and-Wait, Selective-Repeat, and Go-back-N.
3. Develop proficiency in socket programming and network communication protocols using TCP/UDP sockets.

Course Outcomes: After completion of the course, students will be able to:

1. Implement byte stuffing and bit stuffing framing techniques to ensure reliable data transmission in a network environment.
2. Implement Stop-and-Wait, Selective-Repeat, and Go-back-N ARQ protocols to handle errors and ensure data integrity over a network.
3. Develop socket programming skills to create network servers and clients, handle date time extraction, quote serving, and FTP server operations using TCP/UDP sockets.

List of Programs:

1. Implementation of Byte stuffing framing technique
2. Implementation of Bit stuffing framing technique
3. Implementation of Stop-and-Wait ARQ protocol
4. Implementation of Selective-Repeat ARQ protocol
5. Implementation of Go-back-N ARQ protocol
6. Implementation of Echo-back Server using TCP/UDP socket
7. Date & Time extraction from a given server using TCP/UDP socket
8. Implementation of Quote Server using TCP/UDP socket
9. Serving a client by creating a new process using TCP/UDP socket
10. Serving a client by creating a new thread using TCP/UDP socket
11. Implementation of a simple FTP server using TCP/UDP socket
12. Implementation of ping command using TCP/UDP socket

Text Books:

1. N. Matthew, R. S. Stone, *Beginning LINUX programming*, Wiley, 4th Edition, 2008.
2. K. Davis, John W. Turner and Nathan Yocom, *The Definitive Guide to Linux Network Programming*, 1st Ed., Apress, 2004

Reference Books:

1. S. W. Richard Stevens, *UNIX Network programming*, 3rd Ed., PHI Learning Pvt. Ltd, 2006.

2.5.10 IT-PC-LC-313 Operating System Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-313$
Course Name	:	*Operating System Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Learn various system calls related to low level I/O and process.
2. Engage students in practical exercises to understand the concept of various CPU Scheduling algorithms and memory management algorithms.
3. Understand the concept of process synchronization and deadlock through programming activities.

Course Outcomes: After completion of the course, students will be able to:

1. Develop proficiency in using operating system calls in LINUX/UNIX environment.
2. Develop competence in conducting experiments and analyzing results related to process management.
3. Develop competence in conducting experiments and analyzing results related to memory management .
4. Understanding of the process synchronization and deadlock through programming.

List of Programs:

1. Implementation of simple C (at least five) programs using system calls to read and write strings on standard I/O devices and files.
2. Implementation of simple C (at least three) programs using system calls to create a new process, replacing a process image, duplicating a process image, waiting for a process.
3. Implementation of Dining Philosopher problem using shared memory /semaphore.
4. Implementation of bounded-buffer problem using shared memory /semaphore.
5. Simulation of FCFS process scheduling techniques.
6. Simulation of Shortest Job First (both preemptive and non-preemptive version) process scheduling techniques.
7. Simulation of Round Robin process scheduling techniques.
8. Simulation of page replacement algorithms like FIFO, Optimal and LRU.
9. Implementation of threads using POSIX or using thread class in Java.
10. Implementation of (at least one) deadlock avoidance techniques.

Text Books:

1. Stevens, *UNIX programming*, Pearson Education, Pearson Education, 2004.
2. Bhatt P. C. P, An Introduction to Operating Systems, 2nd edition, PHI.

Text Books:

1. A. S. Tanenbaum, *Modern Operating Systems*, 3rd Edition, PHI
2. A. Silberschatz, G. Gagne, and P. B. Galvin, *Operating System Concepts*, 10th ed. Wiley, 2019.

2.6 Sixth Semester

L	-	T	-	P	Cr.
3	-	1	-	0	4

2.6.1 IT-PC-302 Algorithm Analysis and Design

Course Code	:	$IT-PC-302$
Course Name	:	*Algorithm Analysis and Design*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the asymptotic complexity notations for expressing the efficiency of algorithms.
2. Understand different algorithmic paradigms for solving computational problems and methods to prove the correctness and efficiency of algorithms.
3. Know about class of problems P,NP, NP-completeness problem and method to prove that a problem is NP-complete.
4. Familiarize with approximation algorithm for intractable problems.

Course Outcomes: After completion of the course, students will be able to:

1. Prove the correctness of a given algorithm and express the efficiency of the algorithm using asymptotic complexity notations.
2. Choose the appropriate algorithmic paradigm for solving the problem given a computational problem.
3. Prove that a given algorithm is NP-complete using the reduction method.

Unit I
Algorithms and Complexity: asymptotic notations, orders, worst-case and average-case, amortized complexity. Sorting and order statistics: Insertion Sort, Heap Sort, Sorting in linear time, Medians and order statistics.

Unit II
Basic Techniques: divide & conquer: Quicksort, Merge sort, *Dynamic programming*: Overview, difference between dynamic programming and divide and conquer, Matrix chain multiplication, Traveling salesman Problem, longest Common sequence, *Greedy method*: Knapsack problem, Job sequencing with deadlines, Huffman codes, Backtracking: 8-Queen Problem, Sum of subsets. Branch and bound: LC searching Bounding, FIFO branch and bound, *LC branch and bound application*: 0/1 Knapsack problem, Traveling Salesman Problem.

Unit III
Data Structures for Set Manipulation Problems: Fundamental operations on set, Hashing, Binary search, Binary search trees, Optimal binary search trees, A simple-disjoint-set union algorithm, Tree structures for UNION-FIND problem, Application and extensions of the UNION-FIND algorithm, Balanced tree schemes, Dictionaries and priority queues, Mergeable heaps, Concatanable queues, artitioning. Graph Algorithms– BFS and DFS, connected components, spanning trees, shortest paths, max-flow problem

Unit IV
NP- Problems: The classes P and NP problems, NP-completeness of the satisfiability problem, Additional NP complete problems, NP-hard Problems. Approximation algorithms.

Text Books:

1. Cormen, Leiserson and Rivest, *Introduction to Algorithms*, 2nd Ed. Prentice Hall of India, 2004.
2. Aho, Hopcroft and Ullman *The design and Analysis of Algorithms*, Addition-Welsley, 2006.

Reference Books:

1. E. Horowitz and S. Sahani, *Fundamentals of Algorithms*, Galgotia Publications, 2007.
2. U. Manber, *Introduction to Algorithms*, Addison-Wesley, 2009.

2.6.2 IT-PC-304 Software Engineering

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PC-304$
Course Name	:	*Software Engineering*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Acquire the idea of decomposing the given problem into Analysis, Desing, Implementation, Testing and Maintenance phases.
2. Gather an idea of using various process models in the software industry according to given circumstances.
3. Gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project

Course Outcomes: After completion of the course, students will be able to:

1. Decompose the given project in various phases of a lifecycle.
2. Choose appropriate process model depending on the user requirements.
3. Perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Understand various processes used in all the phases of the product.

Unit I
Introduction: Software life-cycle models, Software requirements specification, formal requirements specificationaxiomatic and algebraic specifications, Function-oriented software design.

Unit II
Information Systems and Software Engineering: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, planning and managing the project, design, coding, testing, implementation, maintenance.

Unit III
Project Management: Issues in Project Management, Software Project Management Plan. Software Cost Estimation Techniques, Algorithmic Cost Modeling, The COCOMO Model, Project Scheduling, Software Project Planning.

Unit IV
Object-oriented design: UML, software testing, Software quality- SEI CMM and ISO-9001, Software reliability and fault-tolerance. Computer-aided software engineering (CASE).

Text Books:

1. R. Mall, *Fundamentals of Software Engineering*, Prentice Hall of India Pvt. Ltd., 2009.
2. R. S. Pressman, *Software Engineering A Practitioner's Approach*, McGraw Hill International, 2005.

Reference Books:

1. P. Jalote, *Integrated Approach to Software Engineering*, Narosa Publisher, 1997.
2. Sommerville, *Software Engineering*, 7th Ed., Addison-Wesley, 2005.
3. C. Ghezzi, M. Jazayeri and D. Mandrioli, *Fundamentals of Software Engineering*, 2nd Ed., Prentice Hall of India, 2003.

2.6.3 IT-PC-306 Introduction to Cyber Security

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PC-306$
Course Name	:	*Introduction to Cyber Security*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the issues of cyber security.
2. Use the cryptographic techniques for handling the cyber security issues.
3. Analyze different cryptographic protocols and their security analysis.

Course Outcomes: After completion of the course, students will be able to:

1. Familiarize with the cyber security threat landscape and its dynamic nature
2. Appreciate the role of different cryptographic techniques in ensuring cyber security.
3. Perform basic security analysis based on known attacks.

Unit I
Cyber security and CIS triad. Basic Cyber threats to CIA cyber-attack surfaces, recent cyber-security incidents and their high-level analysis

Basic Cryptography, Role of Cryptography in ensuring confidentiality for data at rest, data in motion, and data in process. Symmetric and Asymmetric Cryptography, their needs as complementary of each other, some basic symmetric and asymmetric algorithm outlines (RSA, DH, DES,AES) Role of cryptography in data integrity, non-repudiation. Hashing and Digital Signature and some example hash function outlines (MD5, SHA-256), understanding digital signature and its role. Digital Certificate and PKI. Importance of the role of a proper Pseudo Random Number Generator

Unit II
Authentication, Authorization and Privilege, Importance of strong Authentication, distinction between authentication and authorization, importance of authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation Intuition of distinguishing between authorization from authentication, access control lists, MAC vs DAC with examples, importance of distinct privileges, principle of least privilege.

Unit III
Application Security: Basic application vulnerabilities (Buffer overflow, Integer Overflow, format string vulnerability), Basic mitigations of buffer overflow –platform bases, compiler based, secure programming practice, Web Client Security, Same Origin Principle, DOM, Java Script Vulnerability, Cookies and Cookie Attributes Secure, http only, Concept of session and session ID, Session hijacking vulnerability, http vs. https and SSL/TLS and version issue Web Server Security – XSS, CSRF, SQL Injection, Command Injection concepts, examples of each and mitigation techniques.
Vulnerabilities in DNS, Routing and IP protocols especially in IPv4 and suggested remedies with DNSSEC,

Unit IV

Perimeter protection and Intrusion Detection Host Intrusion Detection techniques,what are the indicators to look for and how an SIEM tool can consolidate such indicators into a management console, Network Intrusion Detection –signature based vs. behaviour based, Snort. Firewall vs. Intrusion Detection tool, Firewall rules and customization techniques.

Basic Malware Analysis ,Various malware classes and their characteristics Difference between static analysis and dynamic analysis

Text Books:

1. Ross J. Anderson, Security Engineering, Third Edition, Wiley, Nov 2020.
2. W. Stallings, *Cryptography and Network Security - Principles and Practice*, Seventh Edition, Pearson Education, 2017

Reference Books:

1. T. J. Mowbray, *Cybersecurity - Managing Systems, Conducting Testing, and Investigating Intrusions*, Wiley, 2014.
2. J. Graham, R. Olson, and R. Howard, *Cyber Security Essentials*, CRC Press, 2010.

2.6.4 IT-PE-3081 Digital Image Processing

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-OE-3081$
Course Name	:	*Digital Image Processing*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand image processing fundamentals.
2. Learn essential image processing operations.
3. Understand algorithms for image analysis.
4. Familiarize with contemporary applications of digital image processing.

*Course Outcomes:*After completion of the course, students will be able to:

1. Explain the fundamentals of digital image and its processing
2. Implement image enhancement techniques.
3. Develop algorithms for digital image processing.
4. Apply image processing algorithms in practical applications.

Unit I
Introduction to Image Processing, elements of visual perception, image digitization, digital image representation, fundamental steps in image processing, basic relationship between pixels, mathematical operators in image processing.

Unit II
Interpolation and resampling, basic intensity transformations, histogram processing, fundamental of spatial filtering, smoothing and sharpening spatial filters, introduction to Fourier transform, properties of 2d-fourier transform (DFT), filtering in frequency domain, image restoration.

Unit III
Point, line and edge detection, thresholding based segmentation, region based segmentation, Watershed Segmentation, morphological image processing.

Unit IV
Redundancy in images, Image compression models, elements of information theory, lossy compression, lossless compression, image compression standards, image reconstruction from projections, color image processing

Text Books:

1. C. Rafael, Gonzalez and R.E. Woods, *Digital Image Processing*, 3rd Ed., Pearson, 2008.
2. A. K. Jain, *Fundamentals of Digital Image Processing*, Pearson, 2015.

Reference Books:

1. R. J. Schalkoff, *Digital Image Processing and Computer Vision*, John Wiley, 2004.
2. W. K. Pratt, *Digital Image Processing*, John Wiley, 2002.
3. S. Jayaraman, S. Esakkirajan and T. Veerakumar, *Digital Image Processing*, 2nd Ed., McGraw Hill, 2020.

2.6.5 IT-PE-3082 Robotics

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-OE-3082$
Course Name	:	*Robotics*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Familiarize the students to the basic components of a robot and their classifications
2. Know kinematic transformations of a robot.
3. Understand methods for planning and control of robot.

Course Outcomes: After completion of the course, students will be able to:

1. Specify the components and classifications of a robot
2. Specify transformations for forward and inverse kinematics of Robots
3. Solve robot dynamic problems, generate joint trajectory for path planning.

Unit I
ROBOT BASICS: Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot wrist mechanism, Precision and accuracy of robot. *ROBOT ELEMENTS*: End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.

Unit II
Robot Kinematics and Control: Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming

Unit III
Robot Sensors: Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.

Unit IV
Robot Application: Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.

Text Books:

1. S. K. Saha, *Introduction to Robotics*.Tata McGraw-Hill, 2008.
2. J. J. Craig, *Introduction to Robotics: Mechanics and Control*, 3rd ed., Addison-Wesley Publishing Company, 2003

Reference Books:

1. M. P. Groover, M. Weiss, R. N Nagel, and N. G Odrey, *Industrial Robotics Technology, Programming and Applications*, Tata –McGraw Hill Pub. Co., 2008.
2. S. R Deb and S. Deb, *Robotics Technology and Flexible Automation*, Tata McGraw Hill Publishing Company Limited, 2010.
3. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, *Robotics control, sensing, vision and intelligence*, Tata- McGraw Hill Pub. Co., 2008

2.6.6 IT-PE-3083 Bioinformatics

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-OE-3083$
Course Name	:	*Bioinformatics*
Contact Hours per Week	:	*Lectures-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Solve Biological problems those cannot be solved by Biological Wet Laboratory.
2. Develop knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics
3. Devlop problem-solving skills, including the ability to develop new algorithms and analysis methods

Course Outcomes: After completion of the course, students will be able to:

1. Take initiative to find the genes responsible for some disease.
2. Undertake drug design initiative.
3. Link Biological problems with Computer System.

Unit I
Cell Biology: The cell as basic unit of life - Prokaryotic cell and Eukaryotic cell, Cell Structure and Function; cell membrane, cell organelles, Cell Division; Mitosis Meiosis.

Unit II
Bioinformatics databases, Type of databases, Nucleotide sequence databases, Primary nucleotide sequence databases-EMBL, Gene Bank, DDBJ; Protein structure databases, Protein Data Bank-SCOP, CATH, KEGG, Chembank, Protein sequence databases- SwissProt/ TrEMBL, PIR, Sequence motif databases - Pfam, PROSITE.

Unit III
Bio-molecules- DNA, RNA, Protein and amino acids, Chargaff's Rules, Codon bias, GC content. Central Dogma: Replication, Transcription, Translation, Post transcriptional post translational modifications, RNA processing, RNA splicing and RNA editing. Sense/coding and anti-sense/template strands, Genetic code, wobble hypothesis. Introduction to DNA and Protein sequencing, Human Genome Project. Protein structure and function, Protein Primary structure, Amino acid residues, Secondary, Tertiary, Quaternary Structure of Protein,

Unit IV
Computational Biology Algorithms: Suffix Trees, Pair-wise alignment, Sequence Alignment Heuristics, Multiple Sequence Alignment, Hidden Markov Models, RNA Secondary Structure, Bioinformatics Tools, Gene Finding, Phylogeny.

Text Books:

1. G. Karp, *Cell and Molecular Biology – Concepts and Experiments*, 2008, Wiley International Student Version.
2. Durbin, Richard, and S. R. Eddy, *Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids*. Cambridge University Press, 1998.

Reference Books:

1. A. Lesk, *Introduction to Bioinformatics*, Oxford University Press, 2019.
2. N. C. Jones, *An Introduction to Bioinformatics Algorithms*, The MIT Press, 2004.

2.6.7 IT-PE-3084 Internet of Things

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-OE-3084$
Course Name	:	*Internet of Things*.
Contact Hours per Week	:	*Lectures-3, Tutorial-1*.
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60*.
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five*.
Duration of End Semester Examination	:	*3 (Three) Hours*.

Course Objectives: The objectives are to:

1. Understand the fundamentals of the Internet of Things (IoT) including wireless ad-hoc networks and wireless sensor networks.
2. Explore the basic architecture and components of IoT systems and their applications in various domains such as smart cities, healthcare, agriculture, and industrial IoT.
3. Gain knowledge of sensing and actuating devices, sensor types, and microcontrollers used for sensor nodes, edge computing, and gateway nodes in IoT networks.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in understanding machine-to-machine (M2M) communication and the IoT protocol stack including PHY/MAC layer protocols such as 3GPP MTC, IEEE 802.11, and IEEE 802.15.
2. Analyze communication technologies for various IoT networks including Bluetooth Low Energy (BLE), 6LoWPAN, and case studies on IEEE 802.11ah and 6LoWPAN.
3. Develop an understanding of cloud architecture, fog computing, and their application in IoT systems, along with knowledge of open-source IoT platforms, software-defined networks (SDN), and network function virtualization (NFV).

Unit I
Introduction to Internet of Things: Fundamentals of Wireless Ad-hoc networks, Wireless Sensor Networks, Basic IoT architecture and its components, IoT Applications: smart cities, health care, agriculture, Industrial IoT, Sensing and Actuating Devices, Sensor Types, Microcontrollers and single board computers for sensor nodes, edge, and gateway nodes (ESP8266, NodeMCU, Raspberry Pi etc.).

Unit II
Machine to Machine (M2M) communication, IoT Protocol Stack- PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Bluetooth Low Energy (BLE), Network Layer- 6LoWPAN, RPL, Communication Technologies for various IoT networks: Case Studies on communication technologies IEEE 802.11ah, 6LoWPAN.

Unit III
Cloud Architecture and Computing: Evolution and features, Fog Architecture and Computing- Fog protocols, Open source IoT platforms, Software Defined Networks (SDN) and Network Function Virtualization (NFV) for IoT Networks, CoAP and MQTT service architectures

Unit IV
IoT Applications for Value Creations: Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart agriculture, Smart Applications, Four Aspects in your Business to Master IoT, Value creation from Big Data and Serialization, IoT for Retailing Industry.

Text Books:

1. S. Misra, A. Mukherjee, and A. Roy, *Introduction to IoT*, CRC Press, Jan 2022.
2. A. Bahga, V. Madisetti, *Internet of Things A Hands-On- Approach*, Orient Blackswan Private Limited, 2015.

Reference Books:

1. C. Hakima, *The Internet of Things Connecting Objects to the Web*, Wiley Publications, 2010.
2. H. Olivier, B. David, and E. Omar, *The Internet of Things: Key Applications and Protocols*, 2nd ed., Wiley Publications, 2012.

2.6.8 IT-PE-3085 Artificial Intelligence

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-OE-3085$
Course Name	:	*Artificial Intelligence*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Develop advanced AI algorithms and neural network architectures.
2. Designs and creates AI models that can learn patterns in data and make predictions.
3. Focus on developing AI based expert systems.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the Definition of AI, Agents and how it works.
2. Understand the how the computers play Games.
3. Know the importance of Knowledge Representation for an intelligent behavior of a system.
4. Know the working of Rule Based System.

Unit I
Introduction: Introduction to AI and intelligent agents. Problem Solving: Solving Problems by Searching, heuristic search techniques: Hill Climbing, Simulated Annealing , A*, Constraint satisfaction problems.

Unit II
Game Playing and stochastic search methods: Overview, the Minimax Search Procedure, Adding Alpha-Beta Cutoffs, Additional Refinements, Iterative Deepening. Stochastic search methods: Stochastic Hill Climbing, Genetic algorithm.

Unit III
Knowledge Representation: Building a Knowledge Base: Propositional logic, Predicate logic, First Order Logic. AI production System, Basics of Resolution, Conversion to Clause Form, Theorem Proving in First Order Logic, Forward vs. Backward Reasoning, Rule-Based Systems.

Unit IV
Statistical Reasoning:probability and Bayes' theorem, Certainty factors and Rule-Based Systems, Bayesian Networks Learning: Overview of different forms of learning, Learning Decision Trees, Introduction to Neural Networks.

Text Books:

1. N. J. Nelson, *Principle of Artificial Intelligence*, Narosa Publishing House, 2002.
2. E. Rich and K. Knight, *Artificial Intelligence*, McGraw Hill, 1991.
3. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 2nd Ed, Prentice Hall, 2003.

Reference Books:

1. P. H. Winston and B. K. P. Horn, *LISP*, 3rd Ed., Addison-Wesley, 1989.
2. P. Norvig, *Paradigms of Artificial Intelligence Programming: Case studies in Common LISP*, Morgan Kauffman, 1991.
3. Bratko, *Prolog Programming for Artificial Intelligence*, 3rd Ed., Addison-Wesley, 2001.
4. JC Spall, *Introduction to stochastic search and optimization: estimation, simulation and control*, Wiley, 2005.

2.6.9 IT-PC-LC-310 Web Technology Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-310$
Course Name	:	*Web Technology Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Develop practical skills in HTML for designing static web pages.
2. Gain proficiency in CSS for styling web documents.
3. Learn to create interactive web applications using JavaScript.
4. Practice server-side scripting and familiarizing with database applications.

Course Outcomes: After completion of the course, students will be able to:

1. Develop static and dynamic webpage
2. Design responsive web application
3. Code server-side script with PHP/JSP
4. Connect a web application to database.

List of Programs:

1. Designing static web pages containing heading, paragraph, image, links, list, and table using HTML.
2. Write CSS code to style an HTML document by using background, color, font, padding, margin, and border CSS properties.
3. Create a responsive webpage using CSS media queries to adjust the layout and styling based on different screen sizes.
4. Design of interactive web pages using JavaScript.
5. Program to validate forms using JavaScript.
6. Program to select and manipulate DOM elements using jQuery.
7. Program to implement asynchronous data retrieval using AJAX.
8. Write server side script using JSP/PHP to extract and display form parameters.
9. Program to connect PHP/JSP with database and perform basic CRUD (Create, Read, Update, Delete) operations.
10. Implement session management using PHP/JSP to maintain user state across multiple requests.

Text Books:

1. R. Nixon, *Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5*, 4th Ed., O'Reilly, 2015
2. J. Robbins, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, O'Reilly, 2018

Reference Books:

1. L. Ullman, *PHP and MySQL for Dynamic Web Sites*, 4th Ed., Peachpit press, 2011
2. C. Xavier, *Web Technology & Design*, New Age Int. Publisher, 2003.

2.6.10 IT-PC-LC-312 Cyber Security Lab

L	-	T	-	P	Cr.
0	-	0	-	4	2

Course Code	:	$IT-PC-LC-312$
Course Name	:	*Cyber Security Lab*
Contact Hours per Week	:	*Practical-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 20, End Semester Examination: 30.*
Questions to be Set	:	*Ten (Any one question shall be allotted on lottery basis)*
Questions to be Answered	:	*One (Drawn on lottery basis).*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Gain hands-on exposure to cryptographic and security tools and software to deal with security threats, attacks, and vulnerabilities.

Course Outcomes: After completion of the course, students will be able to:

1. Use various security tools for identifying security threats, attacks and vulnerability of software/protocols etc.
2. Define policy and rules for firewalls

List of Programs:

1. Implementation of symmetric and Asymmetric Encryption algorithms using library function
2. Implementation of different Hash functions using library functions.
3. Performing port scanning using tools like NMAP, Super Scanner etc.
4. Installation of Wireshark and perform experiments for sniffing router traffic using it.
5. Exploring vulnerability of different Application Layer Level Protocol using scripting language/tools.
6. Finding Software vulnerability using free software like Nessus etc.
7. writing codes using scripting language for mounting Denial of Service attacks through various techniques.
8. Attacks on Digital Certificates using OpenSSL tool.
9. Installation and configuration of tools like snort etc. for identifying attacks analyzing packet capture file.
10. Configuration of Firewall using IPTABLE.

Text Books:

1. Forouzan, *Cryptography & Network Security*, 4th ed., Tata McGrawHill, 2011.
2. Gregg, *Network Security Test Lab- A Step by Step Guide*, Willey, 2015.

Reference Books:

1. William Stallings and Lawrie Brown, *Computer Security - Principles and Practice*, Addison Wesley Professional, 2008.
2. C. K. Shyamala, N. Harini, T. R. Padmanabhan, *Cryptography and Network Security*, Wiley India, 1st Edition.

2.7 Seventh Semester

L	-	T	-	P	Cr.
3	-	0	-	0	3

2.7.1 IT-PC-401 Machine Learning

Course Code	:	$IT - PC - 401$
Course Name	:	*Machine Learning*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Learn fundamental of the Machine Learning(ML) which is focused on researching, designing, and building self-running ML systems to automate predictive models.
2. Learn how to collecting data, refining ML models, and integrating AI into applications.
3. Design and create ML algorithms that can learn patterns in data and make predictions.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the Basic concept of Supervised Learning (Regression/Classification).
2. Understand the Basic concept of Logistic Regression and Artificial Neural Network.
3. Acquire the knowledge of Unsupervised learning(Clustering).

Unit I
Introduction: Types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Supervised Learning (Regression/Classification), Distance-based methods, Decision Trees, Overfitting. Linear Regression, k-Nearest Neighbour, Feature Selection, Feature Extraction, Bayesian Learning, Naive Bayes, Bayesian Network

Unit II
Logistic Regression, Introduction Support Vector Machine, Neural Network: Single Layer Perceptron, Feed-Forward Multilayer Perceptron, Back-Propagation, Deep Learning.

Unit III
Introduction to Computational Learning Theory, Sample Complexity, Finite Hypothesis Space, VC Dimension, Ensemble Methods, Boosting, Bagging, Random Forests, Introduction to Clustering-mod, Kmeans Clustering, Agglomerative Hierarchical Clustering

Text Books:

1. C. M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.
2. R. O. Duda, P. E. Hart and D. G. Stork, *Pattern Classification*, 2nd Ed., Wiley-Interscience, 2000.
3. T. M. Mitchell, *Machine Learning*, McGraw Hill Education, 2000.

Reference Books:

1. I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*, MIT Press Ltd, 2016.
2. C. M. Bishop *Pattern Recognition and Machine Learning*, 2nd ed., Springer.
3. T. Hastie, R. Tibshirani, and J. Friedman *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed., Springer.

2.7.2 IT-PE-4031 Advanced Computer Architecture

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4031$
Course Name	:	*Advanced Computer Architecture*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Review the fundamental concepts of computer organization and architectural techniques, focusing on RISC processors, instruction set architectures, and parallel processing techniques.
2. Understand the characteristics of RISC processors, differences between RISC and CISC architectures, and methods for measuring processor performance.
3. Explore various parallel processing techniques including instruction-level, thread-level, and process-level parallelism, along with classification of parallel architectures.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing and comparing RISC and CISC processors, and understanding the performance implications of different instruction set architectures.
2. Evaluate the concepts of instruction-level parallelism, including pipelining, hazards in pipelines, and techniques for hazard resolution.
3. Develop knowledge of memory hierarchies, cache memory design, virtual memory, and peripheral devices in computer systems architecture.

Unit I
Review of Basic Organization and Architectural Techniques: RISC processors, Characteristics of RISC processors, RISC Vs CISC, Classification of Instruction Set Architectures, Review of performance measurements, Basic parallel processing techniques: instruction level, thread level and process level, Classification of parallel architectures.

Unit II
Instruction Level Parallelism: Basic concepts of pipelining: Arithmetic pipelines, Instruction pipelines, Hazards in a pipeline: structural, data, and control hazards, Overview of hazard resolution techniques, Dynamic instruction scheduling, Branch prediction techniques, Instruction-level parallelism using software approaches, Superscalar techniques, Speculative execution Review of modern processors: Pentium Processor and ARM Processor.

Unit III
Memory Hierarchies and Peripheral Devices: Basic concept of hierarchical memory organization, Main memories, Cache memory design and implementation, Virtual memory design and implementation, Secondary memory technology, RAID. Bus structures and standards, Synchronous and asynchronous buses, Types and uses of storage devices, Interfacing I/O to the rest of the system, Reliability and availability, I/O system design, Platform architecture

Unit IV
Thread Level and Process Level Parallelism: Centralized vs. distributed shared memory, Interconnection topologies, Multiprocessor architecture, Symmetric multiprocessors, Cache coherence problem, Synchronization, Memory consistency, Multicore architecture, Review of modern multiprocessors, Distributed computers, Clusters, Grid, Mainframe computers.

Text Books:

1. Hennessey and Patterson, *Computer Architecture: A quantitative Approach*, 5th Ed., Morgan Kaufman Publication, 2012.
2. J. P. Shen and M. H. Lipasti, *Modern Processor Design*, McGraw Hill, Crowfordsville, 2005.

Reference Books:

1. D. E. Culler, J. P. Singh, *Parallel computing architecture: A hardware/software approach*, Morgan Kaufmann /Elsevier Publishers, 1999.
2. K. Hwang and Z. W. Xu, *Scalable Parallel Computing*, Tata McGraw Hill, New Delhi, 2003.

2.7.3 IT-PE-4032 Quantum Computing

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4032$
Course Name	:	*Quantum Computing*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Gain knowledge of basic quantum logical operations and algorithms for processing quantum information.
2. Acquire basic knowledge about the practical use of quantum algorithms and quantum programming skills.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the basics of Quantum Computing.
2. Understand how Quantum Computing has been derived from Physics.
3. Develop interest in further research in the domain.

Unit I
Introduction to Quantum Computation: Quantum bits, Bloch sphere presentation of a qubit, multiple qubits.

Unit II
Background Mathematics and Physics, Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

Unit III
Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits. *Quantum Information and Cryptography*: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.

Unit IV
Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search. *Noise and error correction*: Graph states and codes, Quantum error correction, fault-tolerant computation

Text Books:

1. Nielsen and Chuang, *Quantum Computation & Quantum Information*, 10th ed., 2010.
2. N. D. Mermin, *Quantum Computer Science: An Introduction*, CAMBRIDGE UNIV PRESS, 2007.

Reference Books:

1. Nielser, *Quantum Computation And Quantum Information*, Cambridge University Press, 2018
2. V. Kasirajan, *Fundamentals of Quantum Computing*, Springer Nature, 2021.

2.7.4 IT-PE-4033 Pattern Recognition

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4033$
Course Name	:	*Pattern Recognition*
Contact Hours per Week	:	*Lectures-4, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the methodologies, technologies, and algorithms of statistical pattern recognition from a variety of perspectives.
2. Apply different pattern recognition system in real-life applications.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the Basic concept of pattern recognition tasks.
2. Understand the about different methods/techniques for this subject.
3. Explore with real-life applications.

Unit I
Introduction: Basic pattern recognition tasks; The basic structure of a pattern recognition system; Three learning paradigms; The sub-problems of pattern recognition; The nature of statistical pattern recognition; Comparing classifiers.

Unit II
Bayes Decision Theory: General framework; Optimal decisions; Bayes maximum likelihood rule, Nearest Neighbor Classifiers Three approaches to classification: density estimation, regression and discriminant analysis;

Unit III
Feature Selection: Different approaches to Feature Selection; Branch and Bound, Sequential forward and backward selections, GSFS and GSBS, (L, R) algorithm. *Criterion function*: Probabilistic Separability criterion, Error probability based criterion, Entropy based criterion.

Unit IV
Unsupervised learning and clustering, Clustering Large datasets, Syntactic pattern recognition, Decision trees, Applications – Document Recognition.

Text Books:

1. Theodoridis and Koutroumbas, *Pattern Recognition*, Academic Press, 2009.
2. V. S. Devi and M. N. Murty, *Pattern Recognition: An Introduction*, University Press, 2011

Reference Books:

1. R. O. Duda, P. E. Hart and D. G. Stork, *Pattern Classification*, Wiley, 2000.

2.7.5 IT-PE-4034 Wireless Networks

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4034$
Course Name	:	*Wireless Networks*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining four from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the fundamentals of wireless network architectures, including cellular networks, wireless LANs, and design considerations such as cell capacity, interference, and channel characterization.
2. Gain knowledge of wireless communication standards from first to fifth generation, including 802.11, 802.15.4, and 802.16.
3. Explore the physical layer technologies for wireless networks, including spread spectrum, FHSS, DSSS, OFDM, MAC protocols, and routing protocols for multihop wireless networks.

Course Outcomes: After completion of the course, students will be able to:

1. Develop proficiency in analyzing and designing wireless network architectures, considering factors such as cell capacity, interference, and channel characteristics.
2. Apply knowledge of wireless communication standards and physical layer technologies to implement effective wireless communication systems.
3. Understand and evaluate MAC protocols, routing protocols, and transport protocols for wireless networks, including their suitability for different network architectures.

Unit I
Introduction to wireless network architectures: Cellular networks, wireless local area networks, Cellular network design: Cell capacity and reuse, Interference, Characterization of wireless channels, channel modelling, large scale path loss and Shadowing, Fading, multipath propagation. Wireless LANs: 802.11, 802.15.4, and 802.16 Wireless communication standards: first, second, third, fourth and fifth generation wireless communication.

Unit II
Physical layer for wireless networks: Spread spectrum vs. narrow band technology, Basics of FHSS, DSSS and OFDM, MAC protocols for Wireless Networks: Multiple access techniques, Random access, Carrier Sense Multiple Access (CSMA), Conflict free Mobile IP, Handoff management, Ad-hoc routing protocols-AODV, DSR and OLSR

Unit III
Multihop wireless networks: Introduction, Architecture, Sensor and Mesh networks, MAC protocols for Multi-hop wireless networks, Suitability of Ad-hoc Routing protocols in multihop wireless networks, MAC protocols for Sensor and Mesh networks Sensor and Mesh routing protocols.

Unit IV
Wireless TCP: Transport protocols for wireless networks, TCP performance in Wireless networks, TCP protocols for Wireless Networks, Congestion Control in wireless TCP, Wireless Application Protocol (WAP): Protocol stack, security issues.

Text Books:

1. T. S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Ed., Pearson Education India, 2010.
2. C. S. R. Murthy and B. S. Manoj, *Ad-hoc Wireless Networks: Architectures and Protocols*, Pearson Education India, 2006.

Reference Books:

1. D. Tse and P. Viswanath, *Fundamentals of Wireless Communications*, Cambridge University Press, 2005.
2. W. Stallings, *Wireless Communications and Networks*, 2nd Ed. Pearson Education India, 2009.

2.7.6 IT-PE-4035 Human Computer Interface

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4035$
Course Name	:	*Human Computer Interface*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Comprehend the fundamental concepts, principles, and historical evolution of HCI, including its significance in design and usability.
2. Investigate how human perception influences the design of interactive systems and how to effectively present information for user understanding.
3. Analyze both low-level and higher-level human cognitive processes in the context of interaction with digital systems.
4. Understand the principles of web usability, including content analysis, information architecture, and implementation using web technologies.

Course Outcomes: After completion of the course, students will be able to:

1. Critically evaluate HCI principles and practices in various technological contexts, such as desktop applications, web interfaces, and virtual reality systems.
2. Apply user-centered design methods, including task analysis, user observation, and usability analysis, to design and evaluate interactive systems.
3. Demonstrate competence in designing and programming user interfaces using appropriate design patterns, development tools, and programming languages.

Unit I
Introduction: Design, Usability, *Historical Perspective*: machinery, the PC, the GUI, the Web. *Human Perception and Information Presentation*: Perception, gestalt perception, typography, Color, Graphic design, Displays, Paper, and other Output Devices, Information Visualization. *The Human Body and Device Design*: Input Devices and Ergonomics, Virtual Reality.

Unit II
Low-Level Human Cognition: Time-scales and the Illusion of Multi-Tasking, GOMS Keystroke-Level Modeling, Hypothesis Testing and Statistical Significance. *Higher Cognition and Interaction Styles*: Metaphor, Direct Manipulation, Widget Survey, Command Languages, Other Interaction Styles, Choosing Among Interaction Styles.

Unit III
Observing Users: Mindset, Subject-Running Techniques, Usability Studies Usability Analysis: Error Handling, Error Prevention, Cognitive Walkthroughs, Heuristic Evaluation, Usability Guidelines, Choosing Among Usability Methods Specifying and Prototyping: Low-Fidelity Prototyping, Transition Diagrams, Visual Basic Prototyping.

Unit IV
Task Analysis and User-centered Design: Systems Analysis, Techniques: Task Decomposition, CARD, Ethnographic Observation, Allocation of Functions, Usability Engineering in the Business Context. Interface Design and Programming: Forms Design, Interface Design Patterns, Development Tools, Events and Handlers, MVC, Responsiveness Issues. Web Usability: Content Analysis, Information Architecture, Supporting Navigation, Implementation: html, CSS, Javascript, Browser and Device, Dependence, Assigning Functions to Client and Server.

Text Books:

1. B. Shneiderman, C. Plaisant, M. Cohen, S. Jacobs, *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 5th Ed. Pearson, 2009.
2. A. Dix, J.E. Finlay, G. D. Abowd, and R Beale, *Human-Computer Interaction*, 3rd ed. Pearson Education, 2003.

Reference Books:

1. G. J. Kim, *Human-Computer Interaction: Fundamentals and Practice*, 1st ed. Apple Academic Press, 2015.
2. A. Cooper, R. Reimann, D. Cronin, and C. Noessel, *About Face: The Essentials of Interface Design*, 4th ed., Wiley, 2016.

2.7.7 IT-PE-4051 Data Mining

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4051$
Course Name	:	*Data Mining*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from.* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Familiarize with the concepts of data mining, which gives a complete description about the principles, used, applications.
2. Design and implementation of data mining concepts.

Course Outcomes: After completion of the course, students will be able to:

1. Understand about different data mining tasks .
2. Explore with different applications of data mining algorithms.
3. Explore data mining with real-life tasks.

Unit I
Introduction: Basic concept of data mining, Need of mining data, Data mining tasks, Overview of KDD process, Data processing: Overview of data cleaning, integration, transformation, reduction: discretization.

Unit II
Classification: Simple distance based algorithm, kNN, Naïve Bayes, Decision tree: C4.5, ANN: Overview of single layer perception, Confusion matrix, Accuracy, ROC.

Unit III
Clustering: Similarity and distance measures, Partitional: KMeans, PAM, Hierarchical: Single linkage, Density based: DBSCAN.

Unit IV
Association Rules: Basic concept, Interestingness measures, Apriori, FP-growth, Sampling algorithm, Parallel and Distributed Apriori algorithm.

Text Books:

1. M. H. Dunham, *Data Mining: Introductory and Advanced Topics*, Pearson Education, 2001.
2. J. Han and M. Kamber, *Data Mining: Concepts and Techniques*. 2nd ed., Elsevier, 2006.

Reference Books:

1. I. H. Witten and E. Frank, *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann. 2000.
2. D. Hand, H. Mannila and P. Smyth, *Principles of Data Mining*, Prentice-Hall, 2001.
3. A K Pujari. *Data Mining Techniques*, University Press, 2005.

2.7.8 IT-PE-4052 Mobile Computing

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4052$
Course Name	:	*Mobile Computing*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Gain a comprehensive understanding of mobile technologies, including device anatomy, wireless networks, and computing architecture.
2. Develop proficiency in mobility support systems, mobile databases, file systems, and security concerns in mobile computing.
3. Acquire practical skills in Android application development and understand future trends in mobile computing.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate expertise in analyzing and applying mobile technologies to design effective mobile computing solutions.
2. Implement mobility support systems, mobile databases, and security measures to develop secure and reliable mobile applications.
3. Apply knowledge of Android application development to create functional and user-friendly mobile applications, and anticipate future trends in the mobile computing industry.

Unit I
Introduction: Overview of mobile technologies, Anatomy of a mobile device, Survey of mobile devices, Applications of mobile computing, Issues in mobile computing, Limitations of mobile computing, Mobile computing architecture and models. *Wireless Communication Technologies*: Basics of Cellular networks, Cochannel interference, Wireless Networks (802.11, 802.15.4)

Unit II
Support of mobility: Mobile IP, Handoff management, Location management, HLR–VLR schemes, Hierarchical scheme, TCP in the mobile setting, Global Positioning System (GPS). *Mobile Databases*: Mobile database systems, data management, transaction management, query processing, Disconnectivity and consistency in operation, SQLite and Small SQL databases

Unit III
File System for Mobile Computing: Characteristics of mobile file systems, Disconnected File Operations, CODA. *file system security issues in Mobile Computing*: Security Issues, Authentication, Encryption, Cryptographic Tools: Hash, Message Authentication Code (MAC), Digital Signature.

Unit IV
Android Application Development: Introduction to Android- Layers, android components, mapping application to process. Basics of Android application development, Hardware tools, Software tools, Android SDK features, GUI design, event handling, interfacing with other applications. *The future of Mobile Computing*: Upcoming technologies, heterogeneous networks, Internet of Things (IoT), Convergence of Media and Communication Devices

Text Books:

1. J. Schiller, *Mobile Communications*, 2nd Ed., Pearson Education India, 2008.
2. B. Phillips, C. Stewart, B. Hardy, and K. Marsicano *Android Programming*, 2nd Ed., The Big Nerd Ranch Guide, 2015.

Reference Books:

1. Rappaport, *Wireless Communications: Principles and Practice*, 2nd Ed., Pearson Education India, 2010.
2. E. Hellman, *Android Programming- Pushing the limits*, Wiley, 2014.

2.7.9 IT-PE-4053 Advanced Cryptography

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4053$
Course Name	:	*Advanced Cryptography*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Familiarize the students the different cryptographic primitives
2. Familiarize detailed security analysis of cryptographic primitives.
3. Familiarize with the notion of information-theoretic security.

Course Outcomes: After completion of the course, students will be able to:

1. Perform a comprehensive security analysis for a given a cryptographic primitive.
2. Specify need for post-quantum cryptography.

Unit I
Review of number theory and linear algebra, computational complexity, probability and information theory, primality testing, Factorization.

Unit II
Cryptography and cryptanalysis, symmetric key encryption, DES, Triple DES, AES, RC4, modes of operation.

Unit III
Public key encryption, RSA cryptosystem, Diffie-Hellman, elliptic curve cryptography, pairings based cryptography, Rabin cryptosystems, ElGamal cryptosystems, Goldwasser-Micali, Blum-Goldwasser cryptosystems.

Unit IV
Message authentication, digital signature schemes: RSA, ElGamal, ECDSA, Attacks on digital signature, Security handshake pitfalls, Strong password protocols. Introduction to Post quantum cryptography.

Text Books:

1. B. A. Forouzan and D. Mukhopadhyay, *Cryptography and network security*, Tata McGraw-Hill, 2011.
2. D. R. Stinson, *Cryptography Theory and Practice*, Chapman & Hall/CRC, Tylor & Francis group, Newyork,2006.

Reference Books:

1. W. Mao, *Modern Cryptography: Theory & Practice*, Pearson Education, 2004.
2. C. Kaufman, R. Perlman and M. Speciner, *Network Security: Private Communication in a public World*, 2nd Ed., Prentice Hall, 2002.
3. W. Stallings, *Cryptography and Network Security Principles and practice*, 3rd Ed., Pearson Education Asia, 2003.

2.7.10 IT-PE-4054 Distributed Systems

L	-	T	-	P	Cr.
3	-	1	-	0	4

Course Code	:	$IT-PE-4054$
Course Name	:	*Distributed Systems*
Contact Hours per Week	:	*Lectures-3, Tutorial-1.*
Marks Distribution	:	*Internal Assessment: 40, End Semester Examination: 60.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*3 (Three) Hours.*

Course Objectives: The objectives are to:

1. Understand the fundamental concepts and goals of distributed systems, including hardware and software components, design principles, and communication protocols.
2. Explore various communication models in distributed systems, including layered protocols, client-server architecture, remote procedure call, and group communications.
3. Examine processes and processors in distributed systems, including thread management, system models, processor allocation, scheduling techniques, fault tolerance, and real-time considerations.

Course Outcomes:

1. Demonstrate a comprehensive understanding of the goals, components, and design principles of distributed systems.
2. Apply communication models such as client-server architecture and remote procedure call to design and implement distributed applications.
3. Evaluate different approaches to distributed shared memory and apply appropriate consistency models to ensure data coherence in distributed applications.

Unit I
Introduction to Distributed Systems: Goals of distributed system, hardware and software concepts, design issues. Communication in distributed systems: Layered protocols, Client – Server model, remote procedure call and group communications.
Processes and Processors in Distributed Systems: Thread, systems models, Processor allocation, Scheduling in distributed system, fault tolerance and real time distributed system, Load balancing approach.

Unit II
Synchronization in Distributed Systems: Clocks synchronization, Mutual exclusion, Election algorithms, Bully algorithm, ring algorithm, atomic transactions, deadlock in distributed systems, Distributed deadlock prevention, distributed system, fault tolerance and real-time distributed system.

Unit III
Peer to Peer Systems–Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore. Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. Coordination and Agreement-Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

Unit IV Transactions and Concurrency Control-Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering. Distributed Transactions-Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.

Text Books:

1. A. S. Tanenbaum, *Distributed Operating System*, 1st Ed. Pearson Education India, 2002.
2. G. Coulouris, J. Dollimore, T. Kindberg, G. Blair, *Distributed Systems: Concepts and Design*, 5th Ed. Pearson, 2011.

Reference Books:

1. M. Singhal and N. Shivaratri, *Advanced Concepts in Operating Systems*, McGraw Hill Education, 2017.
2. S. Ghosh, *Distributed Systems: An Algorithmic Approach*, 2nd ed. Chapman and Hall/CRC, 2014.

2.7.11 IT-OE-4071 Operation Research

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4071$
Course Name	:	*Operation Research*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Six (Q.No. 1 of 15 marks combining all the units and Q.No. 2* to 6 of 10 marks each taking at least one from each unit).
Questions to be Answered	:	*Four (Q.No. 1 is compulsory and taking any three from the rest).*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Model a real-life decision-making problem into a suitable mathematical programming model.
2. Know different techniques to solve optimization problems.
3. Perform network analysis using PERT and CPM

Course Outcomes: After completion of the course, students will be able to:

1. Formulate a decision-making problem into an optimization problem.
2. Solve the optimization problems and interpret the result
3. Perform network analysis using PERT CPM.

Unit I
Introduction to Operation Research and Linear Programming. Linear Programming Problem (LPP), Generalized LPP- Formulation of problems as L.P.P. Solutions to LPP by graphical method ,LPP: Simplex method, Canonical and Standard form of LP problem, slack, surplus and artificial variables, Solutions to LPP by Simplex method, Big-M Method and Two Phase Simplex Method, Degeneracy in LPP. Concept of Duality, writing Dual of given LPP. Solutions to L.P.P by Dual Simplex Method.

Unit II
Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using North-West Corner rule, Vogel's Approximation method. Optimality in Transportation problem by Modified Distribution (MODI) method. Unbalanced T.P. Maximization T.P. Degeneracy in transportation problems, application of transportation problem. Assignment Problem- Formulation, Solutions to assignment problems by Hungarian method, Special cases in assignment problems, unbalanced, Maximization assignment problems. Travelling Salesman Problem (TSP). Difference between assignment and T.S.P, Finding best route by Little's method. Numerical Problems

Unit III
Network analysis: Introduction, Construction of networks, Fulkerson's rule for numbering the nodes, AON and AOA diagrams; Critical path method to find the expected completion time of a project, determination of floats in networks, PERT networks, determining the probability of completing a project, predicting the completion time of project; Cost analysis in networks. Crashing of networks- Problems. Queuing Theory: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), Kendall & Lee's notation of Queuing, empirical queuing models – Numerical on M/M/1 and M/M/C Queuing models.

Text Books:

1. P. K. Gupta and D. S. Hira, *Operations Research*,S. Chand and Company LTD. Publications, 2007.
2. H. A. Taha, *Operations Research, An Introduction*, 7th ed., PHI Private Limited, 2006.

Reference Books:

1. J. K. Sharma, *Operations Research, Theory and Applications*, 6th ed., Trinity Press, Laxmi Publications Pvt. Ltd. 2016.
2. Paneerselvan, *Operations Research*, 3rd ed., PHI Learning, 2023.
3. A. M. Natarajan, P. Balasubramani, *Operations Research*, Pearson Education, 2005.

2.7.12 IT-OE-4072 Soft Computing

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4072$
Course Name	:	*Soft Computing*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Learn different AI techniques or tools.
2. Learn how AI tools are used to make artificial system intelgent
3. Focus on Evolutionary and Stochastic techniques and many more.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the Basic concept of Fuzzy logic, Fuzzification and De-Fuzzification.
2. Understand the working of Artificial Neural Network.
3. Know how Evolutionary and Stochastic techniques help to make an artificial system intelligent.

Unit I
Soft Computing: Introduction, requirement, different tools and techniques, usefulness and applications. Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, Fuzzy Membership Function, operations on fuzzy sets, Fuzzy relations and relation equations, Fuzzy logic, Linguistic hedges, Fuzzification and De-Fuzzification, Fuzzy controllers.

Unit II
Artificial Neural Network: McCulloch-Pitts Neural Network, Hebb's learning, Adaline, Perceptron, Multilayer feed forward network, Back propagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Unit III
Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Simulated annealing , Rough Sets, Reduction of Knowledge, Decision Tables, and Applications, Hybrid Systems.

Text Books:

1. C. Lin and C. S. G. Lee, *Neural Fuzzy Systems*, Prentice Hall, 2006.
2. Klir and Yuan, *Fuzzy Sets and Fuzzy Logic*, PHI, 1997.
3. S. Haykin, *Neural Networks*, 2nd ed., Pearson Education, 2001.
4. D. E. Goldberg, *Genetic Algorithms in Search and Optimization, and Machine Learning*, Addison-Wesley, 1989.

Reference Books:

1. S. Rajasekaran and G. A. V. Pai, *Neural Networks, Fuzzy logic, and Genetic Algorithms*, PHI, 2003.
2. J. Sun and Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 2008
3. V. Kecman, *Learning and Soft Computing*, MIT Press, 2001.
4. Z. Pawlak and Kluwer, *Rough Sets*, Academic Publisher, 1991.

2.7.13 IT-OE-4073 Cloud Computing

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4073$
Course Name	:	*Cloud Computing*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Make students learn about Cloud Fundamentals, cloud characteristics and historical roots.
2. Make students learn about cloud delivery and deployment models.
3. Gain practical experience with CloudSim and GreenCloud. Understand their architectures and working platforms.

Course Outcomes: After completion of the course, students will be able to:

1. Augment Cloud Understanding: Grasp essential cloud computing concepts and historical evolution.
2. Develop proficiency in Cloud Architecture: Identify and explain cloud delivery and deployment models effectively.
3. Gather experience Cloud Simulation: Gain practical experience with CloudSim and GreenCloud for simulating cloud environments.

Unit I
Cloud Computing Overview: Essential characteristics, Architectural Influences, Technological Influences, and Operational Influences, On-demand self service, Broad network access, Location independent resource pooling ,Rapid elasticity , Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

Unit II
Cloud Architecture- Layers and Models: Cloud Delivery models, The SPI Framework, Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. *Cloud deployment model*: Public clouds, Private clouds, Community clouds, Hybrid clouds, Advantages of Cloud computing.

Unit III
Cloud Simulators- CloudSim and GreenCloud: Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud.

Text Books:

1. A. T. Velte , T. J. Velte, and R. Elsenpeter, *Cloud computing a practical approach*, TATA McGraw- Hill, 2010.
2. M. Miller, *Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online*, 1st ed. Que Publishing, 2008.

Reference Books:

1. J. Hurwitz, R. Bloor, M. Kaufman, and F. Halper, *Cloud computing for dummies*, Wiley Publishing, Inc, 2010
2. R. Buyya, J. Broberg , A. Goscinski, *Cloud Computing: Principles and Paradigms*, Wiley, 2013.

2.7.14 IT-OE-4074 Cyber Forensics and Law

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4074$
Course Name	:	*Cyber Forensics and Law*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. To introduce the students the digital cyber forensic tools and techniques
2. To familiarize the students to the provisions of law related to cyber crimes and attacks.

Course Outcomes: After completion of the course, students will be able to:

1. Know how to apply forensic analysis
2. Develop tools to recover important evidence of cybercrime.
3. Conversant with the important provisions of Cyber law.

Unit I

Introduction to Traditional Computer Crime: Traditional problems associated with Computer Crime, Introduction to Identity Theft & Identity Fraud, Types of Computer Forensic techniques – Incident and incident response methodology – Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. Forensics Technology and Systems, Understanding Computer Investigation, Data Acquisition.

Unit II

Processing Crime and Incident Scenes: Working with windows and linux systems, *Current Computer Forensics Tools*: Software/ Hardware Tools like SANS SIFT, ProDiscover, Volatility etc. Validating Forensics Data, Data Hiding Techniques, Performing Remote Acquisition, Network Forensics, Email Investigations, Cell Phone and Mobile Devices Forensics

Unit III

Fundamentals of Cyber Law: Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Uncitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, Copy Right, Trademark law, Law related to semiconductor layout & design.

Text Books:

1. H. Chander, *Cyber Law and IT Protection*, PHI Publication, 2012
2. Phillips, Enfinger, Steuart, *Computer Forensics and Investigations*, Cengage Learning India Edition, 2008.

Reference Books:

1. J. R. Vacca, *Computer Forensics*, Cengage Learning, 2005
2. R. E. Smith, *Internet Cryptography*, 3rd ed., Pearson Education, 2008
3. M. T. Britz, *Computer Forensics and Cyber Crime: An Introduction*, 3rd ed., Prentice Hall, 2013/

2.7.15 IT-OE-4075 Simulation and Modelling

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4075$
Course Name	:	*Simulation and Modelling*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the principles of modeling continuous-time systems using differential equations and simulating them using CSMP and analog computer methods.
2. Gain proficiency in applying probability concepts, including probability mass and density functions, exponential and Poisson distributions, in system modeling.
3. Learn the usage of simulation languages such as GPSS for modeling and simulating dynamic systems.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in modeling continuous-time systems using differential equations and simulating them using appropriate simulation methods.
2. Apply probability concepts effectively to model stochastic aspects of systems and analyze their behavior.
3. Develop skills in building, verifying, calibrating, and validating simulation models, including state-space formulations and feedback systems, using tools like MATLAB and C++.

Unit I
Modeling and Simulation of Continuous time System: Modeling of system in form of differential equations and their simulation using CSMP and Analogue computer method. *Concept of Probability in Modeling*: Probability mass and probability density function. Arrival patterns, exponential distribution, Poisson distribution. Use of GPSS as simulation language.

Unit II
Dynamic System: Definition, representation in graphical form, formulation of dynamic system problem in the shortest route problem, solution of dynamic system. State-space formulation and solution technique. Feedback systems and use of MATLAB and C++ for simulation of deterministic and stochastic systems.

Unit III
Building and Verification of Simulation Models, Calibration and Validation of Models, Validation of Model Assumptions, Validating Input, Output Transformations.

Text Books:

1. Gordon, *System Simulation*, 2nd ed., PHI, 1978.
2. Deo, *System Simulation using Digital Computer*, 2nd Ed., PHI, 1978.

Reference Books:

1. Leigh, *Simulation & Modelling*, Peter Perigrims Limited, 1983.
2. Law and Kelton, *Simulation Modelling & Analysis*, McGraw Hill, 1982.

2.7.16 IT-P-409 Minor Project

L	-	T	-	P	Cr.
0	-	0	-	12	6

Course Code	:	$IT-P-409$
Course Name	:	*Minor Project*
Contact Hours per Week	:	*Lectures-0, Practical-12.*
Marks Distribution	:	*Internal Assessment: 60, End Semester Examination: 90.*

Course Objectives: The objectives are to:

1. Provide students for knowledge of software engineering and use of computer programs for problem solving.
2. Aquire knowledge of computational intelligence in different fields of computation.
3. Design and development of Small intelligent project based on knowledge gathered throughout the course.

Course Outcomes: After completion of the course, students will be able to:

1. Practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. Reproduce, improve and refine technical aspects for engineering projects.

Modalities of B. Tech (IT) Minor Project

Each student individually or in a group will undertake a sizeable project involving a survey of the literature, development of new techniques and/or implementation of systems, writing of reports etc. under the guidance of one or more faculty members of the department. The evaluation of the minor project shall be done as per the guidelines laid down in RC-20.

2.8 Eighth Semester

L	-	T	-	P	Cr.
3	-	0	-	0	3

2.8.1 IT-OE-4021 E-Commerce

Course Code	:	$IT-OE-4021$
Course Name	:	*E-Commerce*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the electronic commerce environment, including technologies, modes, and opportunities in the field.
2. Explore different approaches to safe electronic commerce, focusing on secure transactions, payment protocols, authentication, and security measures.
3. Gain knowledge of specific electronic commerce technologies such as Mastercard/Visa Secure Electronic Transaction and email technologies for secure communication.

Course Outcomes: After completion of the course, students will be able to:

1. Demonstrate proficiency in analyzing and navigating the electronic commerce environment, identifying opportunities and challenges.
2. Apply knowledge of secure electronic commerce approaches to design and implement safe transaction systems.
3. Develop practical skills in using specific electronic commerce technologies such as Mastercard/Visa Secure Electronic Transaction and secure email technologies for business communication.

Unit I
Electronic commerce environment and opportunities: Introduction, The Electronic commerce Environment, *Electronic Marketplace Technologies Modes of electronic commerce*: Overview, EDI, Migration to open EDI, E-commerce with WWW/Internet, Commerce Net Advocacy, Web commerce going forward.

Unit II
Approaches to safe electronic Commerce: Overview, Source, Transport Protocols, Secure Transactions, Secure Electronic Payment Protocol, Secure Electronic Transaction, Certificates for Authentication, Security on Web Servers and enterprise networks, Electronic cash and electronic payment schemes, Internet Monetary Payment and Security requirements, payment and purchase order process, online electronic cash.

Unit III
Master card/ Visa Secure electronic transaction: Introduction, Business requirements, Concepts, Payment Processing. *Email and Secure Email Technologies for Electronic Commerce*: Introduction, the means of Distribution, A model for Message Handling, How Does a Email Work.

Text Books:

1. Daniel Minoli, Emma Minoli, *Web Commerce Technology Handbook*, McGraw Hill, 1999.
2. Kenneth C. Laudon, *E-Commerce : Business, Technology, Society*, 4th ed., Pearson, 2023.

Reference Books:

1. R, Kalakotar, A. B. Whinston, *Frontiers of Electronic Commerce*, Addison-Wesley, 1996.
2. S. J. Joseph, *E-Commerce: an Indian perspective*, PHI, 2006.

2.8.2 IT-OE-4022 Management Information System

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4022$
Course Name	:	*Management Information System*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. To provide students with a comprehensive understanding of management concepts, organizational structures, and systems.
2. To familiarize students with the role and importance of management information systems (MIS) in organizations.
3. To enable students to understand the decision-making process at different managerial levels.
4. To introduce students to various types of decision support systems (DSS) and their components.

Course Outcomes: After completion of the course, students will be able to:

1. Define and explain key management concepts, including the functions of management and organizational behavior.
2. Analyze and compare different organizational structures and cultures, identifying their implications for management and decision-making processes.
3. Identify and categorize different types of group conflicts and propose strategies for conflict resolution.

Unit I

Conceptual Background of Management, Organization, and System Management: Definition and functions of Management. Organization: A general model of Organization and its internal environment. *Organization behavior*: organization structure and culture, Group Conflict -types, Management Information System–definition, Importance of MIS, MIS function in organization, MIS management. System: components of a system- Open system vs. Closed system.

Unit II

Management and Decision Making: Management Level: top level management, middle level management and low level management. Different managerial role- Informational Role, Informative Role and Decisional Role Managerial decision making: Types of decision- decision making process –Rational decision making. Effectiveness vs. efficiency, MIS Planning. *Management Information System Framework*: A management information systems framework: (consisting Transaction processing system TPS, Management reporting system MRS, Decision support system DSS).

Unit III

Decision Support System (DSS) and Executive Information System (EIS): Decision support system (DSS): Introduction, Component of DSS, characteristics of DSS, model management system LAMP, DSS Generators IFPS (Interactive financial planning system). *Expert system and Artificial Intelligence AI*: introduction, current application of expert System, advantages, knowledge Engineering, expert system shell, *VP-expert Executive information system (EIS)*: Executive roles & decision making, Executive decision making environment.

Text Books:

1. C. S. V. Murthy, *Management Information Systems*, Himalaya Publishing House, 2009.
2. K. C. Laudon and J. P. Laudon, *Management Information System :Managing the digital firm*, 15th ed. Pearson Education, 2018.

Reference Books:

1. A. Leon, *Enterprise Resource Planning*, McGraw Hill Education, 2007.
2. S. A. Kelkar, *Management Information Systems: A Concise Study*, 2nd Revised ed. PHI, 2009.

2.8.3 IT-OE-4023 Deep Learning

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4023$
Course Name	:	*Deep Learning*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the idea of artificial neural networks and their architecture.
2. Familiarize with the techniques used for training artificial neural networks.
3. Design and deployment of deep learning models for machine learning problems.

Course Outcomes: After completion of the course, students will be able to:

1. Analyze the given dataset for designing a neural network based solution
2. Carry out design and implementation of deep learning models for signal/image processing applications
3. Design and deploy simple TensorFlow-based deep learning solutions to classification problems

Unit I
Artificial Neural Networks: The Neuron-Expressing Linear Perceptrons as Neurons-Feed-Forward Neural Networks, Linear Neurons and Their Limitations, Sigmoid, Tanh, and ReLU Neurons, Softmax Output Layers, Training Feed-Forward Neural Networks, Gradient Descent-Delta Rule and Learning Rates, Gradient Descent with Sigmoidal Neurons, The Backpropagation Algorithm-Stochastic and Minibatch Gradient Descent, Test Sets, Validation Sets, and Overfitting, Preventing Overfitting in Deep Neural Networks, Implementing Neural Networks in TensorFlow.

Unit II
Local Minima in the Error Surfaces of Deep Networks, Model Identifiability, Spurious Local Minima in Deep Network, Flat Regions in the Error Surface, Momentum-Based Optimization, Learning Rate Adaptation

Unit III
Convolutional Neural Networks(CNN): Architecture, Accelerating Training with Batch Normalization, Building a Convolutional Network using TensorFlow, Visualizing Learning in Convolutional Networks, Embedding and Representation Learning, Autoencoder Architecture, Implementing an Autoencoder in TensorFlow, DenoisingSparsity in Autoencoders Models for Sequence Analysis, Recurrent Neural Networks, Vanishing GradientsLong Short-Term Memory (LSTM) Units, TensorFlow Primitives for RNN Models-Augmenting Recurrent Networks with Attention.

Text Books:

1. N. Buduma, *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithm*, O'Reilly, 2017.
2. I. Goodfellow, Y. Bengio and A. Courville, *Deep Learning*, MIT Press, 2016.

Reference Books:

1. A. Géron, *Hands-On Machine Learning with Scikit- Learn and TensorFlow*, O'Reilly, 2017.
2. N. Ketkar, *Deep Learning with Python: A Hands-on Introduction*, Apress, 2017.

2.8.4 IT-OE-4024 Entrepreneurship

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4024$
Course Name	:	*Entrepreneurship*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Understand the role of entrepreneurs in economic growth and the factors influencing entrepreneurial growth.
2. Explore different types of entrepreneurs and distinguish between entrepreneurs and intrapreneurs.
3. Gain insights into the motives driving entrepreneurs and the various entrepreneurship development programs available

Course Outcomes: After completion of the course, students will be able to:

1. Develop a comprehensive understanding of entrepreneurship and its significance in economic development.
2. Analyze the major motives influencing entrepreneurs and apply stress management techniques in entrepreneurial contexts.
3. Acquire knowledge of financial aspects relevant to entrepreneurship, including sources of finance, capital structure, working capital management, costing, taxation, and corrective measures for small business sickness.

Unit I
Introduction to Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic growth, Factors affecting entrepreneurial growth.

Unit II
Major motives influencing an Entrepreneur – Achievement motivation training, self rating, business games, thematic apperception test – stress management, entrepreneurship development programs – need, objectives.

Unit III
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, and Taxation – Income Tax, GST. Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures.

Text Books:

1. S. S. Khanka, *Entrepreneurial Development* S.Chand & Co. Ltd., 2013.
2. D. F. Kuratko, *Entrepreneurship – Theory, Process and Practice*, 9th ed., Cengage Learning 2014.

Reference Books:

1. R. D. Hisrich and M. P. Peters, *Entrepreneurship*, 8th ed., Tata McGraw-Hill, 2013.
2. M. J. Manimala, *Entrepreneurship theory at cross roads: paradigms and praxis*, 2nd ed., Dream tech, 2005.
3. R. Roy, *Entrepreneurship*, 2nd ed., Oxford University Press, 2011.

2.8.5 IT-OE-4025 Information Theory and Coding

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4025$
Course Name	:	*Information Theory & Coding*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Familiarize themselves with various source coding and error control coding techniques and their performance analysis.
2. Train themselves to design coding schemes for data compression and error correction, and they will also get an overall perspective of how this impacts the design of an optimum communication receiver.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the basics of Probability Theory, significance of "Information" with respect to Information Theory.
2. Differentiate between source coding and error control coding.
3. Understand the principles behind these coding techniques.

Unit I
Introduction to Probability – Random Variables, Random variable, Sample space, Conditional probability, Joint probability. Modeling of Information Sources – Self Information, Entropy, Mutual Information. Source Coding Theory and algorithms – Kraft inequality, Huffman algorithm, Arithmetic coding, Lempel Ziv coding. Modeling of Communication channels – Binary symmetric channel, Binary Erasure channel, Channel coding theorem.

Unit II
Error Correction Codes – Introduction to Galois fields, polynomial arithmetic, linear block codes for error correction – Generator matrix, Encoding, Parity Check matrix, Decoding – Standard array decoding and Syndrome decoding. Cyclic Codes – Generation of codes, encoding and syndrome decoding.

Unit III
BCH Codes – Minimal polynomial encoding and decoding. Convolutional encoder – Introduction to Convolutional codes, distance properties – Trellis codes, Viterbi decoder.

Text Books:

1. S. Lin and D. Castello, *Error Control Coding – Fundamentals and Applications*, 2nd ed., 2004.
2. R. Bose, *Information Theory, Coding and Cryptography*, Tata McGraw Hill, 2nd ed., 2008.

Reference Books:

1. T. M. Cover and J. Thomas, *Elements of Information Theory*, MGH, 2006.
2. R. Bose, *Information Theory, Coding and Cryptography*, 3rd ed., McGraw Hill Education, 2017.
3. P. S. Satyanarayana, *Concepts of Information Theory and Coding*, Dynaram Publication, 2005

2.8.6 IT-OE-4026 Research Methodology

L	-	T	-	P	Cr.
3	-	0	-	0	3

Course Code	:	$IT-OE-4026$
Course Name	:	*Research Methodology*
Contact Hours per Week	:	*Lectures-3, Tutorial-0.*
Marks Distribution	:	*Internal Assessment: 30, End Semester Examination: 45.*
Questions to be Set	:	*Eight (one from each unit and remaining questions from* the combination of more than two units)
Questions to be Answered	:	*Any Five.*
Duration of End Semester Examination	:	*2.5 (Two and Half) Hours.*

Course Objectives: The objectives are to:

1. Gain an understanding the nature of the problem to be studied and identify the related area of knowledge.
2. Review literature to understand how others have approached or dealt with the problem.
3. Collecting data in an organized and controlled manner to arrive at valid decisions.
4. Analyze data appropriate to the problem.

Course Outcomes: After completion of the course, students will be able to:

1. Understand the basics of Quantum Computing.
2. Understand how Quantum Computing has been derived from Physics.
3. Develop interest in further research in the domain.

Unit I
Introduction: Concept of research; Objectives of research; Types of research; Steps to be followed to carry out research; Research Methods and Methodologies; Various stages of Research; Selection of a research topic and problem; Attributes of a Research Scholar; Points to be kept in mind to do good research; Concept Research ethics;

Unit II
Research Components: How to read a paper; How to find a research topic; How to write a paper; How to present a research citation in front of audience; How to write a thesis; How to choose a relevant dataset;

Unit III
Associated Tools of a research: How to write a paper or slides using LATEX; Results representation using graphical tools like MS Excel, ORIGIN or similar tools, Presentation of Photographs in papers using suitable appropriate software platforms.

Text Books:

1. R. Panneerselvam, *Research Methodology*, Prentice Hall India Learning Private Limited, 2013.
2. D. Chawla, N. Sondhi, *Research Methodology: Concepts and Cases*, Vikas Publishing House, 2016.

Reference Books:

1. J. W. Creswell and J. D. Creswell, *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, Sage Publication, 2022.
2. C. R. Kothari and G. Garg, *Research Methodology, Methods And Techniques*, New Age International Publishers, 2023.

2.8.7 IT-P-404 Major Project

L	-	T	-	P	Cr.
0	-	0	-	24	12

Course Code	:	$IT-P2-404$
Course Name	:	*Major Project*
Contact Hours per Week	:	*Lectures-0, Practical-24.*
Marks Distribution	:	*Internal Assessment: 120, End Semester Examination: 180.*

Course Objective:The objectives are to:

1. To provide students with knowledge of software engineering and the use of computer programs for problem-solving.
2. Understand computational intelligence in different fields of computation.
3. Design and development of Small intelligent project based on knowledge gathered throughout the course.

Course Outcome:

1. Students will be able to practice acquired knowledge within the chosen area of technology for project development.
2. Identify, discuss and justify the technical aspects of the chosen project with a comprehensive and systematic approach.
3. Reproduce, improve and refine technical aspects for engineering projects.

Modalities of B. Tech (IT) Major Project

Each student individually or in a group will undertake a sizeable project involving a survey of literature, development of new techniques and/or implementation of systems, writing of reports etc. The evaluation of the major project shall be done as per the guidelines laid down in RC-20.

2.8.8 IT-P-406 Grand Viva

L	-	T	-	P	Cr.
0	-	0	-	0	2

Course Code : $IT - P - 406$
Course Name : *Grand Viva*
Marks Distribution : *End Semester Examination: 50.*

Modalities of B. Tech (IT) Grand Viva

Overall course proficiency will be evaluated through a grand viva covering all the subjects studied during entire B.Tech.

2.8.9 IT-P-408 Internship

L	-	T	-	P	Cr.
0	-	0	-	0	3

Course Code : $IT - P - 408$
Course Name : *Internship*
Marks Distribution : *End Semester Examination: 75.*

Course Objectives: The objectives are to:

1. Learn through "hands-on" experiences at a qualified place of employment.
2. Engage in activities which are supervised by an agency employee, and will acquire the skills and knowledge base necessary to become successful.

Course Outcomes: After completion of the course, students will be able to:

1. Learn the application of knowledge in real-world problems.
2. Get exposure to teamwork and leadership quality.
3. Deal with industry professionals and ethical issues in the work environment.

Ordinarily the internship shall be undertaken before commencement of semester classes. The students needs to submit a report on the work he has carried out during the internship period duly certified by the supervisor. The evaluation of the internship shall be done based on the submitted report and a seminar presented by the student to the Department.