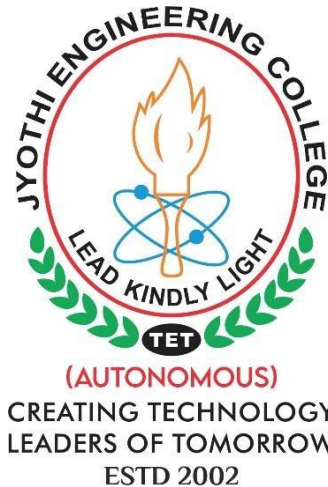


B. TECH SYLLABUS - 2025



Semester I to VIII

COMPUTER SCIENCE AND ENGINEERING CYBER SECURITY

Branch Code: CC

Syllabus approved by the Board of Studies Meeting held on 29.08.2025.

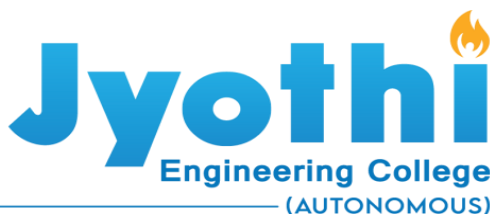
Ref: JEC/CC/2025/BoS/MOM/01 Clause BoS/01/A1 Dated: 29.08.2025



Jyothi
Engineering College
(AUTONOMOUS)

Reaccredited with NAAC (Grade A) and
NBA Programmes* (*CE, CS, EC, EE, ME, MR)
Jyothi Hills, P. O. Vettikkattiri, Cheruthuruthy
Thrissur, Kerala, India, 679531
04884 259000 | info@jecc.ac.in | www.jecc.ac.in

A Centre of Excellence in Science and Technology by the Catholic Archdiocese of Trichur



Reaccredited with NAAC (Grade A) and
NBA Programmes* (*CE, CS, EC, EE, ME, MR)
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04884 259000 | info@jecc.ac.in | www.jecc.ac.in

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VISION & MISSION OF THE INSTITUTE

VISION : Creating eminent and ethical leaders through quality professional education with emphasis on holistic excellence.

MISSION

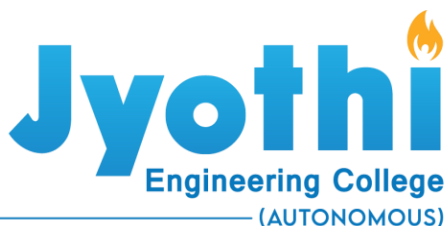
- To emerge as an institution par excellence of global standards by imparting quality engineering and other professional programmes with state-of-the-art facilities.
- To equip the students with appropriate skills for a meaningful career in the global scenario.
- To inculcate ethical values among students and ignite their passion for holistic excellence through social initiatives.
- To participate in the development of society through technology incubation, entrepreneurship and industry interaction.

VISION & MISSION OF THE DEPARTMENT

VISION: To become a globally recognized institute in Cyber Security fostering effective innovation and encouraging research aimed at creating skilled professionals to safeguard the evolving digital landscape from current threats in cyber space.

MISSION

- Committed to deliver value-based education, empowering students to become ethically grounded in theoretical and practical aspects of computing and security technologies.
- To promote Cyber Security research and foster innovation through active collaboration with industry partners and esteemed academic institutions.



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PROGRAMME EDUCATIONAL OBJECTIVES

The graduates of Cyber security will

PEO1. Graduates will be able to develop themselves progressively in various technical or managerial roles using quality education acquired in the field of cyber security.

PEO2. Graduates will be able to advance themselves and to adapt quickly to new environments and technologies, assimilate new information efficiently, and thrive in multi-disciplinary settings with a strong focus on innovation and entrepreneurship.

PEO3. Graduates will be to apply the knowledge of various tools and techniques gained through program to identify, counter and recover from cyber threats.

PROGRAMME SPECIFIC OUTCOMES

PSO1. Graduates will demonstrate the ability to identify and assess cyber threats and apply appropriate tools, methods, and techniques to protect data, systems, and networks.

PSO2. Graduates will gain knowledge with respect to ever growing threats including both hardware and software.

PSO3. Graduates develop skills to anticipate future cyber threats without compromising Cyber laws and individual's privacy.



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PROGRAMME OUTCOMES

- PO1.Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
- PO2. Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3. Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4. Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8)
- PO5. Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).
- PO6. The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7)
- PO7. Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8. Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9. Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- PO10. Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to

one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11. Life-Long Learning: Recognize the need for, and have the preparation and ability for
i) independent and life-long learning ii) adaptability to new and emerging technologies
and iii) critical thinking in the broadest context of technological change. (WK8)

SEMESTER 1

**Computer Science & Engineering
(Cyber Security)**

SEMESTER S1
MATHEMATICS FOR INFORMATION SCIENCE – 1

Course Code	25MAT101	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge in single variable calculus	Course Type	Theory

Course Objectives:

1. To provide students with essential skills in analyzing functions of several variables, identifying extrema, and optimizing processes to preparing them to address diverse engineering applications and challenges.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Limits of Function Values, Continuity at a point, Continuous Functions, Rates of Change: Derivative at a Point, Derivative as a Function, Second- and Higher-Order Derivatives, Instantaneous Rates of Change, Chain Rule, Implicit Differentiation, Tangents and Normal Lines, Linearization, Concavity: The Second Derivative Test for Concavity. [Relevant topics from: Text 1- sections 2.2, 2.5, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.9, 4.4]	9
2	Functions of Several Variables: Domains and Ranges, Level curves of two variables, Limits for functions of two variables, Continuity for functions of two variables, Partial derivatives of a functions of more than two variables, Partial derivatives and continuity, Second- Order partial derivatives, The mixed derivative theorem, The Chain Rule: Functions of two variables [Relevant topics from: Text 1- sections 14.1, 14.2, 14.3, 14.4]	9

3	The Chain Rule: Functions of three Variables, Directional Derivatives in the Plane, Interpretation of the Directional Derivative, Gradient, Properties of the Directional Derivative, Local Extreme Values for Functions of Two Variables: Relative extrema, First derivative theorem for local extreme values, Critical point, saddle point, Second Derivative Test for Local Extreme Values, Absolute Maxima and Minima on Closed Bounded Regions. [Relevant topics from: Text 1- sections 14.4, 14.5, 14.7]	9
4	Constrained Maxima and Minima, The Method of Lagrange Multipliers with one constraint, The Method of Lagrange Multipliers with two constraints, Method of Steepest Descent (only two variables), LPP- Formation, Solution of LPP using graphic method. [Relevant topics from: Text-1 section 14.8, Text-2 sections 22.1, 22.2, 22.3]	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply various concepts in calculus to linearize functions and to analyze concavity.	K3
CO2	Calculate the limits for functions of two variables and partial derivatives of multivariable functions.	K3
CO3	Interpret directional derivative and solve maxima and minima of multivariable functions.	K3
CO4	Solve constrained maxima and minima, LPP and understand the method of Steepest Descent.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thomas' Calculus	Maurice D. Weir, Joel Hass, Christopher Heil, Przemyslaw Bogacki	Pearson	15 th edition, 2023
2	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10 th edition, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Calculus	Howard Anton, Irl Bivens, Stephens Davis	Wiley	10 th edition, 2012
2	Optimization: Algorithms and Applications	Rajesh Kumar Arora	CRC Press	1 st edition, 2015
3	Multivariable Calculus	Ron Larson, Bruce Edwards	Brooks/Cole, Cengage Learning	10 th edition, 2014
4	Calculus & Its Applications	Goldstein, Schneider, Lay, Asmar	Pearson	14 th edition, 2018
5	Bird's Higher Engineering Mathematics	John Bird	Taylor & Francis	9 th edition, 2021
6	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39 th edition, 2023

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/111106146
2	https://nptel.ac.in/courses/111107108
3	https://nptel.ac.in/courses/111107108
4	https://nptel.ac.in/courses/111107108

SEMESTER 1 / 2
PHYSICS FOR INFORMATION SCIENCE

Course Code	25PHT101	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory + Lab

Course Objectives:

1. To equip students with a strong foundation in the fundamentals of Physics, impart this knowledge within the context of Information Science disciplines, cultivate scientific attitudes and critical thinking skills, and enable students to integrate Physics concepts with their core Information Science programs.
2. To make the students gain practical knowledge to correlate the theoretical studies and to develop practical applications of engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Electrical conductivity Classical free electron theory, Electrical conductivity in metals, Fermi Dirac distribution, Variation of Fermi function with temperature, Fermi Energy, Energy bands, Classification of materials into conductor, semiconductor and insulator. Superconductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors. BCS Theory, Applications of superconductors.	9

2	Quantum Mechanics Introduction, Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Application of uncertainty principle- Absence of electron inside nucleus - Natural line broadening, Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (Qualitative)	9
3	Semiconductor Physics Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative) Formation of p-n junction, Fermi level in semiconductors-intrinsic and extrinsic, Energy band diagram of p-n junction - Qualitative description of charge flow across a p-n junction - Forward and reverse biased p-n junctions, Diode equation (Derivation), I-V Characteristics of p-n junction	9
4	Semiconductor Devices Semiconductor devices- Rectifiers- Full wave and Half wave. Zener diode- VI characteristics, Tunnel diode-VI characteristics, Semiconductor Laser (Construction and working), Applications Photonic devices (Qualitative treatment only) - Photo detectors (Junction and PIN photodiodes), Solar cells- IV Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination-3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 = 24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain electrical conductivity and Superconductivity.	K2
CO2	Explain the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics.	K2
CO3	Apply the fundamentals of Semiconductor Physics in engineering.	K3
CO4	Describe the behaviour of semiconductor materials in semiconductor devices.	K2
CO5	Apply basic knowledge of principles and theories in physics to conduct experiments.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										3
CO2	3										3
CO3	3	3									3
CO4	3										3
CO5	3	3			3						3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Physics	H K Malik and A K Singh	McGraw Hill	2 nd Edition, 2017
2	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6 th Edition, 2003
3	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun murthy	S. Chand	11 th Edition, 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Semiconductor Devices Fundamentals	Robert F Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamental	Robert F Pierret	Pearson Education	2 nd Edition, 2002
3	Solid State Electronic Devices	Ben G Streetman and Sanjay Kumar Banerjee	Pearson Education 6/e	2010
4	Solid State Physics	S.O. Pillai	New age international publishers	10 th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10 th Edition, 2017
7	A Text Book of Engineering Physics	I. Dominic and. A. Nahari,	Owl Books Publishers	Revised Edition, 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/115103108
2	https://nptel.ac.in/courses/115101107 https://nptel.ac.in/courses/115102023
3	https://nptel.ac.in/courses/108106181
4	https://nptel.ac.in/courses/108108112

Continuous Assessment (10 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

iii. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

iv. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

1. Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

Setup and Execution: Proper setup and accurate execution of the experiment or programming task

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 10 Experiments)

Experiment No.	Experiment
1	Diode characteristics
2	Zener diode- V-I characteristics
3	Tunnel diode –V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor

8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics
10	Laser – Determination of wavelength using diffraction grating
11	Laser- To measure the wavelength using a millimetre scale as a grating
12	Compare the variation of current with potential difference, for a metal, filamentbulb and semiconductor diode.
13	Determination of dielectric constant
14	CRO -Measurement of frequency and amplitude of wave forms
15	Photo diode - V-I Characteristics
16	Numerical aperture of optical fiber

SEMESTER S1/S2

CHEMISTRY FOR INFORMATION SCIENCE AND ELECTRICAL SCIENCE

Course Code	25CHT101	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory + Lab

Course Objectives:

1. To equip students with a comprehensive understanding of chemistry concepts that are relevant to engineering applications.
2. To familiarize students with applied topics such as spectroscopy, electrochemistry, and instrumental methods.
3. To raise awareness among students about environmental issues, including climate change, pollution, and waste management, and their impact on the quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Electrochemistry and Corrosion Science (9 Hours) Electrochemical Cell - Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Reference electrodes – SHE & Calomel electrode –Construction and Working - Electrochemical series - Applications – Glass Electrode & pH Measurement-Conductivity- Measurement using Digital conductivity meter. Li-ion battery & H ₂ -O ₂ fuel cell (acid electrolyte only) construction and working. Corrosion –Electrochemical corrosion mechanism (acidic & alkaline	9

	medium) - Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of copper - Electroless plating of copper.	
2	Materials for Electronic Applications (9 Hrs) Nanomaterials - Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Carbon Nanotubes, Fullerenes, Graphene & Carbon Quantum Dots – structure, properties & application. Polymers - Fire Retardant Polymers- Halogenated & Non-halogenated polymers (Examples only)- Conducting Polymers-Classification- Polyaniline & Polypyrrole-synthesis, properties and applications. Organic electronic materials and devices - construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC) Materials used in Quantum computing Technology, Super capacitors, Spintronics	9
3	Molecular Spectroscopy and Analytical Techniques (9 Hours) Spectroscopy -Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of conjugation in absorption maxima- Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO ₂ and H ₂ O – Applications Thermal Analysis: Dielectric Thermal Analysis (DETA) of Polymers- Working and Application. Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	9
4	Environmental Chemistry (9Hrs) Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Degree of hardness (Numericals) Water softening methods-Ion exchange process- Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water	9

	disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- Definition & Significance. Waste Management: Sewage water treatment- Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process. E Waste, Methods of disposal – recycle, recovery and reuse. Chemistry of climate change- Greenhouse Gases- Ozone Depletion-Sustainable Development- an introduction to Sustainable Development Goals.	

Self-Study Topics (NOT TO BE INCLUDED FOR END SEMESTER EXAMINATION):

Construction, working and applications of Lead acid battery, Nickel cadmium battery and Nickel metal hybrid battery.

**Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination- 3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the Basic Concepts of Electrochemistry and Corrosion to explore the possible applications in various engineering fields	K2
CO2	Describe the use of various engineering materials in different industries	K2
CO3	Apply appropriate analytical techniques for the synthesis and characterization of various engineering materials.	K3
CO4	Outline various water treatment and waste management methods	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									2
CO2	3	3									2
CO3	3	3									2
CO4	3	3				3					2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S. Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International Edition- 2018
3	Instrumental Methods of Analysis	H. H. Willard, L. L. Merritt	CBS Publishers	7th Edition- 2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17 th Edition - 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4 th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47 th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4 th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ https://www.youtube.com/watch?v=BeSxFLvk1h0
2	https://archive.nptel.ac.in/courses/113/104/113104102/ https://archive.nptel.ac.in/courses/104/105/104105124/ https://archive.nptel.ac.in/courses/105/104/105104157/

Continuous Assessment (10 Marks)

Continuous assessment evaluations are conducted based on laboratory associated with the theory.

Mark distribution

1. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. **Result (2 Marks)**

- Accuracy of Results: Precision and correctness of the obtained results.

3. **Viva Voce (1 Marks)**

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

List of Experiments

***Any 10 Experiments Mandatory**

Expt. Nos.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
7	Determination of molar absorptivity of a compound (KMnO_4 or any water-soluble food colorant)
8	Analysis of IR spectra

9	Identification of drugs using TLC

10	Estimation of total hardness of water-EDTA method
11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil

15	Verification of Nernst equation for electrochemical cell.

SEMESTER S1

ENGINEERING GRAPHICS AND COMPUTER AIDED DRAWING

Course Code	25EST103	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2-0-2-0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory & Lab

Course Objectives:

1. To learn the principles and techniques of dimensioning and preparing engineering drawings.
2. To develop the ability to accurately interpret and understand engineering drawings.
3. To learn the features of CAD software

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction: Relevance of technical drawing in engineering field.Types of lines, Dimensioning, BIS code of practice for technical drawing. (No questions for the end semester examination) Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of a line. Inclination of lines with reference planes. True length and true inclinations of line inclined to both the reference planes.	9
2	Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder only. Projection of solids in simple position including profile view.	9

	Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.	
3	Sections of Solids: Sections of Prisms, Pyramids, Cone and Cylinder only, with axis in vertical position and cut by different section planes. True shape of the sections. (Exclude true shape given problems) Development of Surfaces: Development of surfaces of the solids and solids cut by different section planes. (Exclude problems with through holes)	9
4	Isometric Projection: Isometric scale- Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Sphere, Hemisphere and their combinations. Computer Aided Drawing (CAD): Introduction, Role of CAD in design and development of new products, Advantages of CAD. Creating two- dimensional drawing with dimensions using suitable software. (CAD, only internal evaluation)	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment+ Lab Exam	Internal Examination-1	Internal Examination- 2	Total
5	10+5	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

2 Questions from one module Total 8 Questions, each question carries 15 marks (15x4 =60marks)	Total
	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the projection of points and lines located in different quadrants	K2
CO2	Prepare multiview orthographic projections of objects by visualizing them in different positions	K3
CO3	Plot sectional views and develop surfaces of a given object	K3
CO4	Prepare pictorial drawings using the principles of isometric projection	K3
CO5	Sketch simple drawing using CAD tools.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	3	2									
CO3	3	2									
CO4	3	2									
CO5	3	2	2		3						

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Graphics	Varghese, P. I.	V I P Publishers	2018 edn
2	Engineering Graphics,	Benjamin, J.	Pentex Publishers	2016 edn
3	Engineering Graphics	John, K. C.	Prentice Hall India Publishers	2017 edn
4	Engineering Drawing,	Bhatt, N., D.	Charotar Publishing House Pvt Ltd.	60th edn 2019
5	Engineering Graphics,	Anilkumar, K. N.	Adhyuth Narayan Publishers	2022 edn

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Graphics with AutoCAD,	Kulkarni, D. M., Rastogi, A. P. and Sarkar, A. K.,	Prentice Hall India Publishers	2020 edn
2	Engineering Drawing & Graphics	Venugopal, K.	New Age International Publishers	5th edn 2011
3	Engineering Drawing	Parthasarathy, N. S., and Murali, V.	Oxford University Press	2015 edn

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/112/102/112102304/
2	https://archive.nptel.ac.in/courses/112/102/112102304/
3	https://archive.nptel.ac.in/courses/112/102/112102304/
4	https://archive.nptel.ac.in/courses/112/102/112102304/

SEMESTER S1
INTRODUCTION TO ELECTRICAL AND ELECTRONICS
ENGINEERING

Course Code	25EST104	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	4:0:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Group Core-Theory

Course Objectives:

1. Apply fundamental concepts and circuit laws to solve simple DC/AC electric circuits
2. Classify series and parallel magnetic circuits
3. Analyse three phase AC systems
4. Describe the fundamental concepts of electronic components and devices
5. Outline the principles of communication systems
6. Identify various applications of modern electronics in the contemporary world

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Elementary concepts of DC electric circuits: Current and Voltage Division Rule - Relative potential Capacitors & Inductors: V-I relations and Energy stored. Ohms Law and Kirchhoff's laws - numerical problems. Star-delta conversion (<i>resistive networks only - derivation not required</i>) - numerical problems. Analysis of DC Electric circuits: Mesh current method - matrix representation - Solution of network equations.	11

	Node voltage methods-matrix representation-solution of network equations by matrix methods - numerical problems. Elementary Concepts of Magnetic circuits: Magnetic Circuits: Basic Terminology: MMF, field strength, fluxdensity, reluctance - Comparison between electric and magnetic circuits - Series and parallel magnetic circuits with composite materials (<i>numerical problems not needed</i>)	
2	Electromagnetic Induction: Faraday's laws, Lenz's law- statically induced and dynamically induced emf – Self-inductance and mutual inductance, coefficient of coupling (<i>numerical problems not needed</i>) Alternating Current fundamentals: Generation of alternating voltages - Representation of sinusoidal waveforms: frequency, period, average value, RMS value and form factor - numerical problems AC Circuits: Phasor representation of sinusoidal quantities, Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance - numerical problems. RL, RC and RLC series circuits- power factor, active, reactive and apparent power. Simple numerical problems. Three phase AC systems: Generation of three phase voltages, advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- numerical problems	11
3	Introduction to Electronic devices: Passive and active components in electronics Working of PN junction diode, V-I characteristics of PN Junction diode	13

	Concept of biasing and load line Transistor as a switch, Transistor as an amplifier (Circuit Diagram and working) RC coupled amplifier - Circuit diagram and frequency response Introduction to FET, Construction and working of N-channel and P-Channel MOSFETs	
4	Modern Electronics and its applications: General block diagram of a Communication system, Block diagram of Fiber optic Communication system Concept of AM and FM (No derivation required), Block diagram of AM and FM super-heterodyne receiver Basic concepts of Wired and Wireless communication, Block diagram of GSM Comparison of 3G, 4G, 5G and 6G communication technologies Block diagrams of Electronic instrumentation system, Digital Multimeter, Function generator Introduction to CRO and Lissajous patterns Applications of modern electronics – IoT based smart homes, healthcare and agriculture (<i>Case study only</i>)	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)
Continuous Internal Evaluation Marks

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one fullquestion out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply fundamental concepts and circuit laws to solve simple DC/AC electric circuits	K2
CO2	Classify series and parallel magnetic circuits	K2
CO3	Analyse three phase AC systems	K2
CO4	Explain the fundamental concepts of electronic components and devices	K2
CO5	Outline the principles of communication systems	K2
CO6	Identify various applications of modern electronics in the contemporary world	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	2										
CO3	3	2									
CO4	2	1									
CO5	2										
CO6	3		1			3					

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
2	Schaum's Outline of Basic Electrical Engineering	J.J.Cathey and Syed A Nasar	Tata McGraw Hill	3/e 2010
3	Basic Electronics: Principles and Applications	Chinmoy Saha, Arindham Halder and Debarati Ganguly	Cambridge University Press	1/e 2018
4	Basic Electrical and Electronics Engineering	D. P. Kothari and I. J. Nagrath	McGraw Hill	2/e 2020
5	The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World	Michael Miller	QUE	1/e 2015
6	Basic Electronics and Linear Circuits	N N Bhargava D C Kulshreshtha and S. C. Gupta	McGraw Hill	2/e 2017
7	Electronic Communication Systems	Kennedy and Davis	McGraw Hill	6/e 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Electrical Engineering	D C Kulshreshtha	Tata McGraw Hill	2/e 2019
2	Electrical Engineering Fundamentals	Del Toro V	Pearson Education	2/e 2019
3	Basic Electrical Engineering	T. K. Nagsarkar, M. S. Sukhija	Oxford Higher Education	3/e 2017
4	Electronics: A Systems Approach	Neil Storey	Pearson	6e 2017
5	Electronic Devices and Circuit Theory	Robert L. Boylestad and Louis Nashelsky	Pearson	11e 2015
6	Principles of Electronic Communication Systems	Frenzel, L. E	MGH	4e 2016
7	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill	1/e 2017
8	Electronic Communication	Dennis Roddy and John Coolen	Pearson	4/e 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Basic Electrical Engineering	D C Kulshreshtha	Tata McGraw Hill	2/e 2019
2	Electrical Engineering Fundamentals	Del Toro V	Pearson Education	2/e 2019
3	Basic Electrical Engineering	T. K. Nagsarkar, M. S. Sukhija	Oxford Higher Education	3/e 2017
4	Electronics: A Systems Approach	Neil Storey	Pearson	6e 2017
5	Electronic Devices and Circuit Theory	Robert L. Boylestad and Louis Nashelsky	Pearson	11e 2015
6	Principles of Electronic Communication Systems	Frenzel, L. E	MGH	4e 2016
7	Internet of Things: Architecture and Design Principles	Raj Kamal	McGraw Hill	1/e 2017
8	Electronic Communication	Dennis Roddy and John Coolen	Pearson	4/e 2008

SEMESTER S1

ALGORITHMIC THINKING WITH PYTHON

(Common to All Branches)

Course Code	25EST105	CIE Marks	40
Teaching Hours/Week(L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with a thorough understanding of algorithmic thinking and its practical applications in solving real-world problems.
2. To explore various algorithmic paradigms, including brute force, divide-and-conquer, dynamic programming, and heuristics, in addressing and solving complex problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	PROBLEM-SOLVING STRATEGIES:- Problem-solving strategies defined, Importance of understanding multiple problem-solving strategies, Trial and Error, Heuristics, Means-Ends Analysis, and Backtracking (Working backward). THE PROBLEM-SOLVING PROCESS:- Computer as a model of computation, Understanding the problem, Formulating a model, Developing an algorithm, Writing the program, Testing the program, and Evaluating the solution. ESSENTIALS OF PYTHON PROGRAMMING:- Creating and using variables in Python, Numeric and String data types in Python, Using the math module, Using the Python Standard Library for handling basic I/O - print, input, Python operators and their precedence.	7

2	ALGORITHM AND PSEUDOCODE REPRESENTATION:- Meaning and Definition of Pseudocode, Reasons for using pseudocode, The main constructs of pseudocode - Sequencing, selection (if-else structure, case structure) and repetition(for, while, repeat-until loops), Sample problems* FLOWCHARTS** :- Symbols used in creating a Flowchart - start and end, arithmetic calculations, input/output operation, decision (selection), module name (call), for loop (Hexagon), flow-lines, on-page connector, off-page connector. * - Evaluate an expression, $d=a+b*c$, find simple interest, determine the larger of two numbers, determine the smallest of three numbers, determine the grade earned by a student based on KTU grade scale (using if-else and case structures), print the numbers from 1 to 50 in descending order, find the sum of n numbers input by the user (using all the three loop variants), factorial of a number, largest of n numbers (Not to be limited to these exercises. More can be worked out if time permits). ** Only for visualizing the control flow of Algorithms. The use of tools like RAPTOR (https://raptor.martincarlisle.com/) is suggested. Flowcharts for the sample problems listed earlier may be discussed	9
3	SELECTION AND ITERATION USING PYTHON:- if-else, elif, for loop, range, while loop. Sequence data types in Python - list, tuple, set, strings, dictionary, Creating and using Arrays in Python (using Numpy library). DECOMPOSITION AND MODULARIZATION* :- Problem decomposition as a strategy for solving complex problems, Modularization, Motivation for modularization, Defining and using functions in Python, Functions with multiple return values	10

	RECURSION:- Recursion Defined, Reasons for using Recursion, The Call Stack, Recursion and the Stack, Avoiding Circularity in Recursion, <i>Sample problems - Finding the nth Fibonacci number, greatest common divisor of two positive integers, the factorial of a positive integer, adding two positive integers, the sum of digits of a positive number</i> **. * <i>The idea should be introduced and demonstrated using Merge sort, the problem of returning the top three integers from a list of $n \geq 3$ integers as examples. (Not to be limited to these two exercises. More can be worked out if time permits).</i> ** <i>Not to be limited to these exercises. More can be worked out if time permits.</i>	
4	COMPUTATIONAL APPROACHES TO PROBLEM-SOLVING (Introductory diagrammatic/algorithmic explanations only. Analysis not required) :- Brute-force Approach - - <i>Example: Padlock, Password guessing</i> Divide-and-conquer Approach - - <i>Example: The Merge Sort Algorithm</i> - Advantages of Divide and Conquer Approach - Disadvantages of Divide and Conquer Approach Dynamic Programming Approach - <i>Example: Fibonacci series</i> - Recursion vs Dynamic Programming Greedy Algorithm Approach - <i>Example: Given an array of positive integers each indicating the completion time for a task, find the maximum number of tasks that can be completed in the limited amount of time that you have.</i> - Motivations for the Greedy Approach - Characteristics of the Greedy Algorithm - Greedy Algorithms vs Dynamic Programming Randomized Approach - <i>Example 1: A company selling jeans gives a coupon for each pair of jeans. There are n different coupons. Collecting n different coupons would give you free jeans. How many jeans do you expect to buy before getting a free one?</i>	10

	- Example 2: n people go to a party and drop off their hats to a hat-check person. When the party is over, a different hat-check person is on duty and returns the n hats randomly back to each person. What is the expected number of people who get back their hats? - Motivations for the Randomized Approach	

Course Assessment Method
(CIE: 40 marks, ESE: 60marks)
Continuous Internal Evaluation
Marks (CIE):

Attendance	Continuous Assessment (Accurate Execution of Programming Tasks)	Internal Examination-1 (Written Examination)	Internal Examination-2 (Written Examination)	Internal Examination- 3 (Lab Examination)	Total
5	5	10	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Utilize computing as a model for solving real-world problems.	K2
CO2	Articulate a problem before attempting to solve it and prepare a clear and accurate model to represent the problem.	K3
CO3	Utilize effective algorithms to solve the formulated models and translate algorithms into executable programs.	K3
CO4	Interpret the problem-solving strategies, a systematic approach to solving computational problems, and essential Python programming skills	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3								
CO2	3	3	3								
CO3	3	3	3								
CO4	3	3	3								

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Problem solving & programming concepts	Maureen Sprankle, Jim Hubbard	Pearson	9/e, 2011
2	How to Solve It: A New Aspect of Mathematical Method	George Pólya	Princeton University Press	2/e, 2015
3	Creative Problem Solving: An Introduction	Donald Treffinger., Scott Isaksen, Brian Stead-Doval	Prufrock Press	4/e,2005
4	Psychology (Sec. Problem Solving.)	Spielman, R. M., Dumper, K., Jenkins, W., Lacombe, A., Lovett, M., & Perlmutter, M	H5P Edition	1/e, 2021
5	Computational Thinking: A Primer for Programmers and Data Scientists	G Venkatesh Madhavan Mukund	Mylspot Education Services Pvt Ltd	1/e, 2020
6	Computer Arithmetic Algorithms	Koren, Israel	AK Peters/CRC Press	2/e, 2001
7	Python for Everyone	Cay S. Horstmann, Rance D. Necaie	Wiley	3/e, 2024
8	Introduction to Computation and Programming using Python	Gutttag John V	PHI	2/e., 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://opentextbc.ca/h5pppsychology/chapter/problem-solving/
2	https://onlinecourses.nptel.ac.in/noc21_cs32/preview

1. Continuous Assessment (5 Marks)

Accurate Execution of Programming Tasks

- Correctness and completeness of the program
- Efficient use of programming constructs
- Handling of errors
- Proper testing and debugging

2. Evaluation Pattern for Lab Examination (10 Marks)

1. Algorithm (2 Marks)

Algorithm Development: Correctness and efficiency of the algorithm related to the question.

2. Programming (3 Marks)

Execution: Accurate execution of the programming task.

3. Result (3 Marks)

Accuracy of Results: Precision and correctness of the obtained results.

4. Viva Voce (2 Marks)

Proficiency in answering questions related to theoretical and practical aspects of the subject.

Sample Classroom Exercises:

1. Identify three ill-defined problems and well-defined problems
2. Identify five use cases for Trial and error, Heuristics, backtracking, and Means-ends analysis.
3. Use a diagram to solve the Tower of Hanoi for three pegs with the minimum number of moves.
4. Evaluate different algorithms discussed earlier based on their efficiency by counting the number of steps.
5. A recursive function that takes a number and returns the sum of all the numbers from zero to that number.
6. A recursive function that takes a number as an input and returns the factorial of that number.
7. A recursive function that takes a number '**n**' and returns the nth Fibonacci number.
8. A recursive function that takes an array of numbers as input and returns the product of all the numbers in the array.
9. A program to reverse the contents of an **1D** array without using a second array.
10. To register for the end-semester examination, you need to log into the University portal with your credentials. Write a program to validate the credentials. Assume that the usernames are stored in an array of strings called **USERNAME** and the corresponding passwords are stored in another array of strings called **PASSWORD** such that **password[i]** is the password for the user **username[i]**.
11. You are given a list and your task is to divide it to make two smaller lists. The sublists should be made from alternate elements in the original list. So if the original list is **{5,1,4,12,6}**, then one sublist should be **{5,4,6}** and the other should be **{1,12}**.
12. A program that takes three points in a 2D plane and determines whether they are collinear. Two pairs of points are collinear if they have the same slope.

LAB Experiments:

1. Simple desktop calculator using Python. *Only the five basic arithmetic operators.*
2. Create, concatenate, and print a string and access a sub-string from a given string.
3. Familiarize time and date in various formats (Eg. "Thu Jul 11 10:26:23 IST 2024").
4. Write a program to create, append, and remove lists in Python using NumPy.
5. Program to find the largest of three numbers.
6. Convert temperature values back and forth between Celsius (c), and Fahrenheit (f). [Formula: $c/5 = f-32/9$]
7. Program to construct patterns of stars (*), using a nested for loop.
8. A program that prints prime numbers less than *N*.

9. Program to find the factorial of a number using Recursion.
10. Recursive function to add two positive numbers.
11. Recursive function to multiply two positive numbers.
12. Recursive function to find the greatest common divisor of two positive numbers.
13. A program that accepts the lengths of three sides of a triangle as inputs. The program should output whether or not the triangle is a right triangle (Recall from the Pythagorean Theorem that in a right triangle, the square of one side equals the sum of the squares of the other two sides). Implement using functions.
14. Program to define a module to find Fibonacci Numbers and import the module to another program.
15. Program to check whether the given number is a valid mobile number or not using functions. Rules:
 1. Every number should contain exactly 10 digits.
 2. The first digit should be 7 or 8 or 9
16. Input two lists from the user. Merge these lists into a third list such that in the merged list, all even numbers occur first followed by odd numbers. Both the even numbers and odd numbers should be in sorted order.
17. Write a program to play a sticks game in which there are 16 sticks. Two players take turns to play the game. Each player picks one set of sticks (needn't be adjacent) during his turn. A set contains 1, 2, or 3 sticks. The player who takes the last stick is the loser. The number of sticks in the set is to be input.
18. Suppose you're on a game show, and you are given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what is behind the doors, opens another door, say No. 3, which has a goat. He then asks, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?

(source:https://en.wikipedia.org/wiki/Monty_Hall_problem#:~:text=The%20Monty%20Hall%20problem%20is,the%20American%20Statistician%20in%201975.)

SEMESTER S1/S2
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
WORKSHOP

(Common to All Branches except for Civil Engineering Branch)

Course Code	25ESL107	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	ESE Marks (Internal only)	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To create awareness and familiarity with electrical wiring and safety measures to be taken.
2. To Identify various electronic components and to operate various measuring instruments
3. Learn to setup simple electronic circuits on breadboard and PCB

Expt. No.	Experiments
Electrical Workshop (Minimum of 7 Experiments to be done)	
1	a) Demonstrate the precautionary steps adopted in case of Electrical shocks. b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB, familiarize the ratings.
2	Wiring of a simple light circuit for light/ fan point (PVC conduit wiring) and a 6A plug socket with individual control.
3	Wiring of light/fan circuit using two-way switches. (Staircase wiring)
4	Wiring of fluorescent lamp and a power plug (16 A) socket with a control switch.
5	Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6	Familiarisation of step up and step-down transformers, (use low voltage transformers) Measurement and representation of voltage and waveform to scale in graph sheet with the help of CRO
7	Familiarisation of rheostats, measurement of potential across resistance elements and introducing the concept of relative potential using a DC circuit.

8	a) Identify battery specifications using different types of batteries. (Lead acid, Li Ion, NiCd etc.) b) Familiarize different types of earthing (Pipe, Plate Earthing, Mat Schemes) and ground enhancing materials (GEM).
ELECTRONICS WORKSHOP (Minimum of 7 Experiments to be done)	
1	Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol and cost of -Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)
2	Drawing of electronic circuit diagrams using BIS/IEEE symbols and Interpret data sheets of discrete components and IC's
3	Familiarization/Application of testing instruments and commonly used tools. - Multimeter, Function generator, Power supply, CRO, DSO. Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station
4	Testing of electronic components using multimeter - Resistor, Capacitor, Diode, Transistor and JFET.
5	Printed circuit boards (PCB) - Types, Single sided, Double sided, PTH, Processing methods. Design and fabrication of a single sided PCB for a simple circuit.
6	Inter-connection methods and soldering practice. Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions. Soldering practice in connectors and general-purpose PCB, Crimping.

7	Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (Any two)- Fixed voltage power supply with transformer • Rectifier diode • Capacitor filter • Zener/IC regulator Square wave generation using IC 555 timer in IC base.
8	Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
9	Introduction to EDA tools (such as KiCad or Xcircuit)

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Total
5	45	50

End Semester Examination Marks (ESE): (Internal evaluation only)

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- Minimum Pass Mark: The requirement for passing the lab course included in the first-year curriculum is that the student must score a minimum of 50% overall, combining marks from both Continuous Internal Evaluation (CIE) and End Semester Examination (ESE). There is no separate minimum requirement for each component.
- There will not be any relaxation in the attendance requirement.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate safety measures against electrical shocks	K2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Electrical Design Estimating and Costing	K B Raina and S KBhattacharya	New Age International Publishers	2/e 2024
2	Electrical Systems Design	M K Giridharan	I K International Publishing House Pvt. Ltd	3/e 2022
3	Basic Electrical Engineering	D P Kothari and I J Nagrath	Tata McGraw Hill	4/e 2019
4	Basic Electronics and Linear Circuits	NN Bhargava, D C Kulshreshtha and S C Gupta	Mc Graw Hill	2/e 2017

Continuous Assessment with equal weightage for both specializations (45 Marks)

1. Preparation and Pre-Lab Work (10 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

2. Lab Reports and Record Keeping (10 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

3. Viva Voce (10 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Evaluation Pattern for End Semester Examination with equal weightage in both specializations (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S1/S2
HEALTH AND WELLNESS
(Common to all Branches)

Course Code	25HUT106	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	1:0:1:0	ESE Marks	0
Credits	1	Exam Hours	Nil
Prerequisites (if any)	None	Course Type	Theory and Practical

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System. Musculoskeletal System and the Major Muscle groups of the HumanBody. Quantifying Physical Activity Energy Expenditure and Metabolicequivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate -intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic Physical Activity, Exercise and Health-Related Physical Fitness.	4

	FITT principle to design an Exercise programme Components of Health related Physical Fitness: - Cardiorespiratory Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	2
3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - Cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis , flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis -Sedative - Cocaine -Other stimulants, including caffeine -Hallucinogens - Tobacco -Volatile solvents.	4

4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	2

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context.
Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases.
Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

Course Assessment Method(CIE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	2

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context.
Understanding of the Endocrine System
- Developing a fitness profile
- Healthy foods habits for prevention and progression of Lifestyle Diseases.
Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

Course Assessment Method(CIE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	K2
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	K2
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	K2
CO4	Explain the basics of first aid and describe common sports injuries	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				2		3		3	3	2	
CO2				2		3		2	2		
CO3				0		3		3			
CO4				2		3					

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Foundations of Nutrition	Bhavana Sabarwal	Commonwealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A. (2005).	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012
6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010

Continuous Internal Evaluation Marks (CIE): for the Health and wellness course

Students will be evaluated as follows.

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20
Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.
Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations - NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark Scores

V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.
2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.
3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.
4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.
5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.
2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.
3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.
4. Scoring: The score is recorded in centimeters and millimeters as the distance reached by the hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position.

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.
2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).
3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart), Stopwatch
Scoring: Record the maximum number of Curl ups in a certain time period 30 seconds.

Scoring for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	<18
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female How to Perform:

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.
2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back to the starting position with the arms extended.
3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.
4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk

How to Perform:

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.
2. The participants begin on signal (Starting point)- “ready, start”. As they cross the finish line, elapsed time should be announced to the participants.
3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder,

measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes : Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes : Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2
LIFE SKILLS AND PROFESSIONAL COMMUNICATION

(Common to all Branches)

Course Code	25HUT107	CIE Marks	100
Teaching Hours/Week(L: T:P: R)	2:0:1:0	ESE Marks	0
Credits	1	Exam Hours	-
Prerequisites (if any)	None	Course Type	Activity-based learning

Course objectives:

1. To foster self-awareness and personal growth, enhance communication and interpersonal connection skills, promote effective participation in groups and teams, develop critical thinking, problem-solving, and decision-making skills, and cultivate the ability to exercise emotional intelligence.
2. To equip students with the necessary skills to listen, read, write & speak, to comprehend and successfully convey any idea, technical or otherwise
3. To equip students to build their profile in line with the professional requirements and standards.

Continuous Internal Evaluation Marks (CIE):

- Continuous internal evaluation is based on the individual and group activities as detailed in the activity table given below.
- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. They should use online collaboration tools for group activities, report/presentation making and work management.
- Activities are to be distributed between 3 class hours (2L+1P) and 3.5 Self-study hours.
- Marks given against each activity should be awarded fully if the students successfully complete the activity.
- Students should maintain a portfolio file with all the reports and other textual materials generated from the activities. Students should also keep a journal related to the activities undertaken.

- Portfolio and journal are mandatory requirements for passing the course, in addition to the minimum marks required.
- The portfolio and journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through the HMC courses and Mini project course.
- Self-reflection questionnaire shall be given at the beginning of the semester, in between and at the end of the semester based on the guidelines in the manual of the course.

Sl. No.	Activity	Class room (L) / Self Study (SS)	Week of completion	Group / Individual (G/I)	Marks	Skills	CO
1.1	Group formation and self-introduction among the group members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
1.3	Preparation of Gantt chart based on the time plan	SS	1	G	2		
2.1	Take an online personality development test, self-reflect and report	SS	1	I	2	• Self-awareness Writing	CO1
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their • Strengths, • Areas for improvement, • Concerns, • Areas in which he/she hesitates to take advice, • Goals/Expectations, from the point of view of the following assumed roles i) their parent/guardian/mentor ii) their friend/sibling/cousin	L	1	I	2	..Goal setting - Identification of skills and setting goal • Self-awareness • Discussion in groups • Group work- Compiling of ideas • Mind mapping	CO1
2.3	Role-storming exercise 2: Students assume the role of their teacher and write about the	SS	1	I	2		CO1

	• Skills required as a B.Tech graduate • Attitudes, habits, approaches required and activities to be practised during their B.Tech years, in order to achieve the set goals						
2.4	Discuss the skills identified through rolestorming exercise by each one within their own group and improvise the list of skills	L	1	G	2		CO1
2.5	Prepare a mind map based on the rolestorming exercise and exhibit/present it in class	SS	2	G	2		CO1
3	Prepare a presentation on instances of empathy they have observed in their own life or in other's life	L	2 to 4	I	2	• Empathy	CO2
4.1	Each student connects and networks with a minimum of 3 professionals from industry/public sector organizations/other agencies/NGOs/academia (atleast 1 through LinkedIn)	SS	3	I	2	• Workplace awareness	
4.2	Interact with them to understand their workplace details including • workplace skills required • their work experience • activities they have done to enhance their employability during their B.Tech years • suggestions on the different activities to be done during B.Tech years Prepare a documentation of this	SS	3	I	4	• Listening	
						• Communication - interacting with people	
						• Networking through various media including LinkedIn	CO2
						• Discussion in groups	
						• Report preparation	
						• Creativity	
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals Prepare the Minutes of the discussions	SS	3	G	2	Goal setting - Preparation of action plan	CO2
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the workplace dynamics assimilated through in-	L	5	G	4		CO3

	teractions and group discussions						
4.6	Identify their own goal and prepare an action plan for their undergraduate journey to achieve the goal	SS	5	I	2		CO1
5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L	6	G	2		CO3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	SS	6	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
5.4	Arrive at a possible solution using six thinking hat exercise	L	7	G	3		CO3
5.5	Prepare a report based on the problem-solving experience	SS	7	G	2		CO4
6.1	Linkedin profile creation	SS	1	I	2		CO6
6.2	Resume preparation	SS	8	I	2	Profile-building	CO6
6.3	Self-introduction video	SS	8	I	3		CO6
7	Prepare a presentation on instances of demonstration of emotional intelligence	SS	9	I	2	Emotional intelligence	CO2
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	SS	10	G	3	Diversity	CO2, CO5
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	SS	10	I	2	• Interview skills	CO6
10	Take an online listening test, self-reflect and report	SS	11	I	2	Listening skills	CO6
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	• English vocabulary	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2	• English language skills	CO4
11.3	Activity to help students identify commonly misspelled words, commonly mispronounced words and confusing words	L	10	I/G	2	• Writing • Presentation • Group work • Self-reflection	CO4

11.4	Write a self-reflection report on the	SS	12	I	2		CO4

	improvement in English language communication through this course						

11.5	Presentation by groups on the experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L	11 to 12	G	2		CO4, CO5
12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	SS	12	G	4	• Audio-visual presentations creations with the use of technology tools • Effective use of social media platforms • Profile building	CO2, CO4, CO5
12.2	Upload the video content to podcasting platforms or YouTube	SS	12	G	1		CO5
12.3	Add the link of the podcast in their LinkedIn profile	SS	12	G	1		CO5

Table 2. Lab hour Activities (P): 24 Marks

Sl No	Activity	Marks	Skill	CO
1	Hands-on sessions on day-to-day engineering skills and a self-reflection report on the experience gained: 1. Drilling practice using electric hand drilling machines. 2. Cutting of MS rod and flat using electric hand cutters. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water taps rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.	24	Basic practical engineering skills	3
2	Language Lab sessions	-	Language Skills	4

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	K5
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathise, respect diversity, be responsible and understand the need to exercise emotional intelligence	K5
CO3	Develop thinking skills, problem-solving and decision-making skills	K5
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	K6
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	K6
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	K6

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1										1	
CO2					1			3		3	
CO3		1	1		1					1	
CO4					1					1	
CO5					1	1				1	
CO6					1					1	

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press	First Edition, 2022
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury, Publishing PLC	25th Anniversary Edition December 2020

3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business	September 2023
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS	January 2016
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Life Skills for Engineers	Remesh S., Vishnu R.G.	Ridhima Publications	First Edition, 2016
2	Soft Skills & Employability Skills	Sabina Pillai and Agna Fernandez	Cambridge University Press	First Edition, 2018
3	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
4	English Grammar in Use	Raymond Murphy,	Cambridge University Press India PVT LTD	5th Edition 2023
5	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York	2004

SEMESTER 2

SEMESTER S2
MATHEMATICS FOR INFORMATION SCIENCE – 2

Course Code	25MAT201	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Elementary matrix operations	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of linear algebra focusing on fundamental concepts and applications, and to develop necessary skills to effectively utilize linear algebra in advanced studies and professional practice.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Linear systems of equations, Solution by Gauss elimination, Row echelon form and rank of a matrix, Fundamental theorem for linear systems - homogeneous and non-homogeneous (without proof), Eigen values and Eigen vectors of matrices, Diagonalization of matrices. [Text 1: Relevant topics from sections 7.3, 7.4, 7.5, 8.1, 8.4]	9
2	Vector Spaces, Examples of vector space – R^n and $M_{m \times n}$ only, Subspaces, Examples as subspaces of R^n and $M_{m \times n}$, Linear combinations of vectors in a vector space, Spanning sets, Linear dependence and independence, Basis for a vector space, The dimension of vector space, Coordinate representation in R^n , Change of basis in R^n : Transition Matrix (without proof). [Text 2: Relevant topics from sections 4.2, 4.3, 4.4, 4.5, 4.7]	9

3	Vector length and unit vector, Dot product and angle between two vectors, The Cauchy- Schwarz Inequality, Inner product, Examples as R^n and $M_{2 \times 2}$, Properties of inner products, Definitions of length, distance and angle, Orthogonal projections in inner product spaces, Orthogonal and orthonormal sets, Orthogonal and orthonormal basis, Gram-Schmidt orthonormalization process (without proof), The least squares problem, Orthogonal Subspaces, Solving the least square problems. [Text 2: Relevant topics from sections 5.1, 5.2, 5.3, 5.4]	9
4	Linear Transformations, Properties of linear transformations, Linear Transformation given by a matrix, Rotation in R^2, Projection in R^3, Kernel of a Linear Transformation and its basis, Range of a Linear Transformation and its basis, Rank and Nullity of a Linear Transformation, Sum of Rank and Nullity (without proof), Matrices for Linear Transformations. [Text 2: Relevant topics from sections 6.1, 6.2, 6.3]	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Solve system of linear equations, to evaluate eigen values and eigen vectors of matrices and to diagonalize matrices.	K3
CO2	Understand the concepts of vector spaces and subspaces and to apply their properties.	K3
CO3	Describe inner product spaces and their properties, to apply orthonormalization process and to solve least square problems.	K3
CO4	Understand the concept of linear transformation and to apply its properties to find the rank and nullity of a linear transformation and to find the matrices of linear transformations.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	2	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10 th edition, 2016
2	Elementary Linear Algebra	Ron Larson	Cengage Learning	8 th edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mathematics for Machine Learning	Marc Peter Deisenroth, A. Aldo Faisal & Cheng Soon Ong	Cambridge University Press	1 st edition, 2020
2	Linear algebra and learning from data	Gilbert Strang	Wellesley-Cambridge Press	1 st edition, 2019
3	Elementary Linear Algebra	Stephen Andrilli & David Hecker	Academic Press Inc.	4 th edition, 2010
4	Elementary Linear Algebra	Howard Anton, Chris Rorres	Wiley	11 th edition, 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/111/107/111107164/
2	https://archive.nptel.ac.in/courses/111/107/111107164/
3	https://archive.nptel.ac.in/courses/111/107/111107164/
4	https://archive.nptel.ac.in/courses/111/107/111107164/

SEMESTER S1 /S2
PHYSICS FOR INFORMATION SCIENCE

Course Code	25PHT101	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory + Lab

Course Objectives:

1. To equip students with a strong foundation in the fundamentals of Physics, impart this knowledge within the context of Information Science disciplines, cultivate scientific attitudes and critical thinking skills, and enable students to integrate Physics concepts with their core Information Science programs.
2. To make the students gain practical knowledge to correlate the theoretical studies and to develop practical applications of engineering.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Electrical conductivity Classical free electron theory, Electrical conductivity in metals, Fermi Dirac distribution, Variation of Fermi function with temperature, Fermi Energy, Energy bands, Classification of materials into conductor, semiconductor and insulator. Superconductivity, Transition temperature, Critical field, Meissner effect, Type I and Type II Super conductors. BCS Theory, Applications of superconductors.	9
2	Quantum Mechanics Introduction, Concept of uncertainty and conjugate observables	9

	(qualitative), Uncertainty principle (statement only), Application of uncertainty principle- Absence of electron inside nucleus - Natural line broadening, Wave function – properties - physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one- dimensional box - Derivation of energy eigen values and normalized wave function, Quantum Mechanical Tunnelling (Qualitative)	
3	Semiconductor Physics Intrinsic semiconductor, Derivation of density of electrons in conduction band and density of holes in valence band, Intrinsic carrier concentration, Variation of Intrinsic carrier concentration with temperature, Extrinsic semiconductor (qualitative) Formation of p-n junction, Fermi level in semiconductors-intrinsic and extrinsic, Energy band diagram of p-n junction - Qualitative description of charge flow across a p-n junction - Forward and reverse biased p-n junctions, Diode equation (Derivation), I-V Characteristics of p-n junction	9
4	Semiconductor Devices Semiconductor devices- Rectifiers- Full wave and Half wave. Zener diode- VI characteristics, Tunnel diode-VI characteristics, Semiconductor Laser (Construction and working), Applications Photonic devices (Qualitative treatment only) - Photo detectors (Junction and PIN photodiodes), Solar cells- IV Characteristics, Efficiency, Stringing of Solar cells to solar panel, Light Emitting Diode, Applications	9

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3										3
CO2	3										3
CO3	3	3									3
CO4	3										3
CO5	3	3			3						3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Physics	H K Malik and A K Singh	McGraw Hill	2 nd Edition, 2017
2	Concepts of Modern Physics	Arthur Beiser	Tata McGraw Hill Publications	6 th Edition, 2003

3	A Textbook of Engineering Physics	MN Avadhanulu, P G Kshirsagar, TVS Arun murthy	S. Chand	11 th Edition, 2018
Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Semiconductor Devices Fundamentals	Robert F Pierret	Pearson Education	1995
2	Advanced Semiconductor Fundamental	Robert F Pierret	Pearson Education	2 nd Edition, 2002
3	Solid State Electronic Devices	Ben G Streetman and Sanjay Kumar Banerjee	Pearson Education 6/e	2010
4	Solid State Physics	S.O. Pillai	New age international publishers	10 th Edition, 2022
5	Introduction to Solid State Physics	Charles Kittel	Wiley India Edition	2019
6	Advanced Engineering Physics	Premlet B	Phasor Books	10 th Edition ,2017
7	A Text Book of Engineering Physics	I. Dominic and. A. Nahari,	Owl Books Publishers	Revised Edition, 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/115103108
2	https://nptel.ac.in/courses/115101107 https://nptel.ac.in/courses/115102023
3	https://nptel.ac.in/courses/108106181
4	https://nptel.ac.in/courses/108108112

Continuous Assessment (10 Marks)

i. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

ii. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

iii. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

iv. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

Experiment List

(Minimum 10 Experiments)

Experiment No.	Experiment
1	Diode characteristics
2	Zener diode- V-I characteristics
3	Tunnel diode –V-I characteristics
4	Half wave rectifier
5	Full wave rectifier
6	Hall effect in semiconductors
7	Determination of band gap energy of a semiconductor
8	Characteristics of LED
9	Solar Cell- V-I and Intensity Characteristics
10	Laser – Determination of wavelength using diffraction grating
11	Laser- To measure the wavelength using a millimeter scale as a grating

12	Compare the variation of current with potential difference, for a metal, filament bulb and semiconductor diode.

13	Determination of dielectric constant
14	CRO -Measurement of frequency and amplitude of wave forms
15	Photo diode - V-I Characteristics
16	Numerical aperture of optical fiber

SEMESTER S1/S2
CHEMISTRY FOR INFORMATION SCIENCE

Course Code	GXCYT122	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory + Lab

Course Objectives:

1. To equip students with a comprehensive understanding of chemistry concepts that are relevant to engineering applications.
2. To familiarize students with applied topics such as spectroscopy, electrochemistry, and instrumental methods.
3. To raise awareness among students about environmental issues, including climate change, pollution, and waste management, and their impact on the quality of life.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Electrochemistry and Corrosion Science (9 Hours) Electrochemical Cell- Electrode potential- Nernst equation for single electrode and cell (Numerical problems)- Reference electrodes – SHE & Calomel electrode –Construction and Working - Electrochemical series - Applications – Glass Electrode & pH Measurement-Conductivity- Measurement using Digital conductivity meter. Li-ion battery & H₂-O₂ fuel cell (acid electrolyte only) construction and working. Corrosion –Electrochemical corrosion mechanism (acidic & alkaline medium) - Galvanic series - Corrosion control methods - Cathodic Protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of copper - Electroless plating of copper.	9

2	Materials for Electronic Applications (9 Hrs) Nanomaterials - Classification based on Dimension & Materials- Synthesis – Sol gel & Chemical Reduction - Applications of nanomaterials – Carbon Nanotubes, Fullerenes, Graphene & Carbon Quantum Dots – structure, properties & application. Polymers - Fire Retardant Polymers- Halogenated & Non-halogenated polymers (Examples only)- Conducting Polymers-Classification- Polyaniline & Polypyrrole-synthesis, properties and applications. Organic electronic materials and devices- construction, working and applications of Organic Light Emitting Diode (OLED) & Dye-Sensitized Solar Cells (DSSC) Materials used in Quantum computing Technology, Super capacitors, Spintronics	9
3	Molecular Spectroscopy and Analytical Techniques (9 Hours) Spectroscopy-Types of spectra- Molecular energy levels - Beer Lambert's law – Numerical problems - Electronic Spectroscopy – Principle, Types of electronic transitions –Role of conjugation in absorption maxima- Instrumentation-Applications – Vibrational spectroscopy – Principle- Number of vibrational modes - Vibrational modes of CO₂ and H₂O – Applications Thermal Analysis: Dielectric Thermal Analysis (DETA) of Polymers- Working and Application. Electron Microscopic Techniques: SEM - Principle, instrumentation and Applications.	9
4	Environmental Chemistry (9Hrs) Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Degree of hardness (Numericals) Water softening methods-Ion exchange process- Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. – Water disinfection methods – chlorination-Break point chlorination, ozone and UV irradiation. Dissolved oxygen (DO), BOD and COD- Definition & Significance. Waste Management: Sewage water treatment- Primary, Secondary and	9

	Tertiary - Flow diagram -Trickling filter and UASB process. E Waste, Methods of disposal – recycle, recovery and reuse. Chemistry of climate change- Greenhouse Gases- Ozone Depletion-Sustainable Development- an introduction to Sustainable Development Goals.	

Self-Study Topics (NOT TO BE INCLUDED FOR END SEMESTER EXAMINATION):

Construction, working and applications of Lead acid battery, Nickel cadmium battery and Nickel metal hydride battery.

**Course Assessment
Method (CIE: 40 marks,
ESE: 60 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Continuous Assessment	Internal Examination-1 (Written)	Internal Examination-2 (Written)	Internal Examination-3 (Lab Examination)	Total
5	10	10	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the Basic Concepts of Electrochemistry and Corrosion to explore the possible applications in various engineering fields	K2
CO2	Describe the use of various engineering materials in different industries	K2
CO3	Apply appropriate analytical techniques for the synthesis and characterization of various engineering materials.	K3
CO4	Outline various water treatment and waste management methods	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									2
CO2	3	3									2
CO3	3	3									2
CO4	3	3				2	3				2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Chemistry	B. L. Tembe, Kamaluddin, M. S.Krishnan	NPTEL Web-book	2018
2	Physical Chemistry	P. W. Atkins	Oxford University Press	International Edition- 2018
3	Instrumental Methods of Analysis	H. Willard, L. L.Merritt	CBS Publishers	7th Edition-2005
4	Engineering Chemistry	Jain & Jain	Dhanpath Rai Publishing Company	17 th Edition - 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Molecular Spectroscopy	C. N. Banwell	McGraw-Hill	4 th edn., 1995
2	Principles of Physical Chemistry	B. R. Puri, L. R. Sharma, M. S. Pathania	Vishal Publishing Co	47 th Edition, 2017
3	Introduction to Spectroscopy	Donald L. Pavia	Cengage Learning India Pvt. Ltd	2015
4	Polymer Chemistry: An Introduction	Raymond B. Seymour, Charles E. Carraher	Marcel Dekker Inc	4 th Revised Edition, 1996
5	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Prof. Dr. C. N. R. Rao, Prof. Dr. h.c. mult. Achim Müller, Prof. Dr. A. K. Cheetham	Wiley-VCH Verlag GmbH & Co. KGaA	2014
6	Organic Electronics Materials and Devices	Shuichiro Ogawa	Springer Tokyo	2024
7	Principles and Applications of Thermal Analysis	Gabbot, P	Oxford: Blackwell Publishing	2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/104/106/104106137/ https://archive.nptel.ac.in/courses/113/105/113105102/ https://archive.nptel.ac.in/courses/113/104/113104082/ https://www.youtube.com/watch?v=BeSxFLvk1h0
2	https://archive.nptel.ac.in/courses/113/104/113104102/ https://archive.nptel.ac.in/courses/104/105/104105124/ https://archive.nptel.ac.in/courses/105/104/105104157/

Continuous Assessment (10 Marks)

Continuous assessment evaluations are conducted based on laboratory associated with the theory.

Mark distribution

1. Preparation and Pre-Lab Work (2 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (2 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (3 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (3 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for Lab Examination (5 Marks)

1. Procedure/Preliminary Work/Conduct of Experiments (2 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

2. Result (2 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.

3. Viva Voce (1 Marks)

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

List of Experiments

***Any 10 Experiments Mandatory**

Expt. Nos.	Experiment
1	Estimation of iron in iron ore
2	Estimation of copper in brass
3	Determination of cell constant and conductance of solutions
4	Calibration of pH meter and determination of pH of a solution
5	Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
6	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
7	Determination of molar absorptivity of a compound (KMnO_4 or any water-soluble food colorant)
8	Analysis of IR spectra
9	Identification of drugs using TLC
10	Estimation of total hardness of water-EDTA method
11	Estimation of dissolved oxygen by Winkler's method
12	Determination of calorific value using Bomb calorimeter
13	Determination of saponification value of a given vegetable oil
14	Determination of acid value of a given vegetable oil
15	Verification of Nernst equation for electrochemical cell.

SEMESTER S2

**FOUNDATIONS OF COMPUTING: FROM HARDWARE
ESSENTIALS TO WEB DESIGN**

Course Code	25EST201	CIE Marks	40
Teaching Hours/Week(L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the students to the fundamental building blocks of an IT infrastructure including the computing systems, its peripherals, Operating Systems and Networking.
2. To make the learners capable of developing and deploying simple and dynamic websites.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Computer Hardware – CPU, Memory - Memory hierarchy: registers, cache, RAM, virtual memory, Motherboard - Computer Peripherals - I/O devices, Storage devices- HDDs, SSDs, optical drives, I/O communication and device management, Interface cards – Buses – Firmware - Boot process	9
2	Binary representation of data and numbers, Integer Representation, Data storage units - bits, bytes, kilobytes, etc., ASCII and Unicode, CPU Architecture and Instruction Set: Basic CPU architecture - ALU, registers, control unit, Instruction format and assembly language (basics only) Fetch-execute cycle and instruction execution.	9
3	Computer System Software - Operating Systems, Basic commands in Linux / Windows, Shell scripting (bash). Computer Communications – LAN, MAN, WAN, Client/Server networks, Peer-to-Peer networks, Topologies. Basics of IP addresses, DHCP, NAT, Network Security (Desktop & Perimeter), DNS, VPN, Routers, Client-Server, Internet, WWW, Web servers.	9

4	Web Design (Basics of HTML, CSS, and JavaScript) – Understanding the web content delivery, Understanding HTML and XHTML Connections, Understanding Cascading Style Sheets, Understanding JavaScript	9

Course Assessment Method

(CIE: 40 marks, ESE:60)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the fundamental components and the working of an IT environment.	K2
CO2	Explain the data representations, CPU architectures, and the basic functioning of a computer.	K2
CO3	Explain the operating systems, computer network architecture, and necessary protocols used.	K2
CO4	Develop simple interactive web pages and validate the inputs.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3									3
CO2	3	3									3
CO3	3	3									3
CO4	3	3	3		3						3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Invitation to Computer Science	G.Michael Schneider, Judith Gersting	Cengage	2/e , 2020
2	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach	Irv Englander	Wiley	5/e, 2014
3	HTML, CSS, and JavaScript All in One, Sams Teach Yourself	Julie C. MeloniJennifer Kyrnin	Pearson	1/e, 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Elements of Computing Systems, second edition: Building a Modern Computer from First Principles	Noam Nisan and Shimon Schocken	The MIT Press	2/e, 2021
2	Peter Norton's Introduction to Computers	Peter Notron	McGrawHill	6/e, 2010
3	Web Design with HTML, CSS, JavaScript and JQuery	Jon Duckett	Wiley	1/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.nand2tetris.org/
2	https://onlinecourses.swayam2.ac.in/nou20_cs05/preview

SEMESTER S2

PROGRAMMING IN C

Course Code	25EST204	CIE Marks	40
Teaching Hours/Week(L: T:P: R)	3:0:2:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To prepare learner to write versatile C programs for solving computational problems that they come across in their professional life.
2. To equip the learner to write efficient C programs using suitable language constructs to solve real world computational problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	C Fundamentals - Character Set, Constants, Identifiers, Keywords, Basic Data types, Variables, Operators and its precedence, Bit-wise operators, Expressions; Statements - Input and Output statements; Structure of a C program; Simple programs. Control Statements - if, if-else, nested if, switch, while, do-while, for, break & continue, nested loops.	9
2	Arrays - Single dimensional arrays, Defining an array, Array initialization, Accessing array elements; Enumerated data type; Type Definition; Two-dimensional arrays – Defining a two-dimensional array; Programs for matrix processing; Programs for sequential search; Bubble sort; Strings - Declaring a string variable, Reading and displaying strings, String related library functions – Programs for string matching.	9

3	Functions - Function definition, Function call, Function prototype, Parameter passing; Recursion; Passing array to function; Macros - Defining and calling macros; Command line Arguments. Structures - Defining a Structure variable, Accessing members, Array of structures, Passing structure to function; Union. Storage Class - Storage Classes associated with variables: automatic, static, external and register.	9
4	Pointers - Declaration, Operations on pointers, Passing pointer to a function, Accessing array elements using pointers, Processing strings using pointers, Pointer to pointer, Array of pointers, Pointer to function, Pointer to structure, Dynamic Memory Allocation. Files- Different types of files in C, Opening & Closing a file, Writing to and Reading from a file, Processing files, Library functions related to file – fseek(), ftell(), fread(), fwrite().	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Infer a computational problem and develop C programs from them using basic constructs of C language including the control statements.	K2
CO2	Develop C programs using arrays, matrices, and strings.	K3
CO3	Utilize functions to find solution to the computational problems by dividing it into a number of modules and abstract data types.	K3
CO4	Develop C programs using pointers for dynamic data handling.	K3
CO5	Use files in C to permanently store and manipulate data.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	-	-	-	-	-	-	3
CO2	3	3	3	3	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	-	-	-	-	3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Programming with C	Byron S Gottfried	Mc Graw Hill	4/e, 2018
2	Problem Solving and Program Design in C	Jeri R. Hanly, Elliot B. Koffman	Pearson	8/e, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The C Programming Language	Brian W. Kernighan andDennis Ritchie	Pearson	2/e, 2015
2	C The Complete Reference	Herbert Schildt	Mc Graw Hill	4/e, 2017
3	Let us C	Yashavant Kanetkar	BPB Publishers	19/e, 2022
4	Programming in ANSI C	E Balagurusamy	Mc Graw Hill	9/e, 2024

SEMESTER S2
ENGINEERING ENTREPRENEURSHIP AND IPR

(Common to all Branches)

Course Code	25EST206	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	2:1:0:0	ESE Marks	40
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Develop a framework for identifying, curating and validating engineering-based business ideas.
2. Learn essential tools for understanding product-market fit and customer needs.
3. Create a comprehensive business plan for a new venture.
4. Gain foundational knowledge of Intellectual Property Rights (IPR) and their importance for startups.
5. Develop skills for prototyping, stakeholder engagement, and team collaboration.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Ideation, Innovation & Entrepreneurship • What is Ideation? • Understanding Innovation • Frameworks for Innovation • The Entrepreneurial Mindset • Starting a Business, types formation statutory compliances. • Resources for Aspiring Entrepreneurs Introduction to Intellectual Property Rights (IPR) • Types of IPR: Patents, trademarks, copyrights, trade secrets Strategies for protecting intellectual property based on the type of innovation	9

	• Role of IPR in securing funding and competitive advantage Importance of building a strong team • Identifying roles • Skill sets • Team dynamics Identifying Pain Points and problem statement • Idea Generation Techniques • Developing and Refining Ideas • Develop strategies for bringing your innovation to life	
2	Problem and solution canvas preparation • Orientation and canvas introduction • Customer needs assessment • Market segmentation • Value proposition • Competitive analysis • Market entry strategy • Market validation • Regulatory and legal considerations Customer profiling • Review of market research • Customer segmentation • Customer profiling • Persona development • Validation and feedback • Prioritization and selection • Communication and messaging Competitor analysis • Identify competitors • Competitor profiling • SWOT analysis • Market positioning • Customer feedback and reviews	9

	• Pricing analysis • Differentiation strategy • Benchmarking and improvement	
3	Business plan preparation • Business plan framework • Market analysis • Product/ service description • Marketing and sales strategy • Operations plan • Financial projections • Risk management Prototype development plan preparation • Prototype requirements analysis • Technical specifications • Development approach • Development timeline • Resource allocation • Testing and quality assurance • Iterative development and feedback loop • Documentation and version control	9
4	Prototype development Stakeholder engagement strategies • Investors • Partners • Customers • Advisors & Mentors	9

Course Assessment Method
(CIE: 60 marks, ESE: 40marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Micro Project	Internal Ex-1	Internal Ex-2	Total
5	35	10	10	60

Micro project / Comprehensive Business Plan:

The course will be evaluated based on a comprehensive Business Plan Report submitted and prototype development evaluation at the end of the course. The report should integrate learnings and activities from each module, demonstrating a deep understanding of the concepts and your ability to apply them to a chosen engineering venture.

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 1 or 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (6x2 =12 marks)	• 2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 9 marks. (4x7 = 28 marks)	40

At the end of the course students should be able to:

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

[illegible]

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Engineering Handbook	Richard C.Dorf	CRC Press	
2	The Innovator's DNA	Clayton M. Christensen and Jeffrey H. Dyer	Harvard Business Review Press;	Revised edition (June 4, 2019)
3	Start with Why	SIMON SINEK	Portfolio	Reprint edition (December 27, 2011)
4	Business Model Generation	Alexander Osterwalder & Yves Pigneur	Wiley	2010
5	The Engineering Entrepreneur: A Practical Guide to Starting and Running a Successful Engineering Business in India	Saibal Gupta and Ashok Jhunjhunwala	Sage Publications	2011
6	Innovation and Entrepreneurship for Engineers	Bharat Bhushan and Seema Bhushan	CRS Press	2016
7	Indian Patent Law	P. Narayanan	Eastern Book Company	2 nd edn/ 2020
8	The Law of Copyright and Designs	B.L. Wadehra	Universal Law	5 th edn/2010
9	Intellectual Property Rights (Including IPR in the Digital Age)	Prabuddha Ganguli	Tata McGraw-Hill Education	2001
10	The Startup India Manifesto: A Guide to the Indian Startup Ecosystem	Rashmi Bansal and Deepinder Goyal	Westland Publications	2020

SEMESTER S1/S2
HEALTH AND WELLNESS
(Common to all Groups)

Course Code	25HUT106	CIE Marks	50
Teaching Hours/Week(L: T:P: R)	1:0:1:0	ESE Marks	0
Credits	1	Exam Hours	Nil
Prerequisites (if any)	None	Course Type	Theory and Practical

Course Objectives:

1. To provide essential knowledge on physical activity, health, and wellness.
2. To ensure students understand body systems, exercise principles, nutrition, mental health, and disease management.
3. To educate students on the benefits of yoga, the risks of substance abuse and basic first aid skills.
4. To equip students with the ability to lead healthier lifestyles.
5. To enable students to design effective and personalized exercise programs.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Human Body Systems related to Physical activity and its functions: Respiratory System - Cardiovascular System . Musculoskeletal System and the Major Muscle groups of the Human Body. Quantifying Physical Activity Energy Expenditure and Metabolic equivalent of task (MET) Exercise Continuum: Light-intensity physical activity, Moderate -intensity physical activity, Vigorous -intensity physical activity. Defining Physical Activity, Aerobic Physical Activity, Anaerobic	4

	Physical Activity, Exercise and Health-Related Physical Fitness. FITT principle to design an Exercise programme Components of Health-related Physical Fitness: - Cardiorespiratory Fitness- Muscular strength- Muscular endurance- Flexibility- Body composition.	
2	Concept of Health and Wellness: Health and wellness differentiation, Factors affecting health and wellness. Mental health and Factors affecting mental health. Sports and Socialization: Sports and character building - Leadership through Physical Activity and Sports Diet and nutrition: Exploring Micro and Macronutrients: Concept of Balanced diet Carbohydrate & the Glycemic Index Animal & Plant - based Proteins and their Effects on Human Health Dietary Fats & their Effects on Human Health Essential Vitamins and Minerals	2
3	Lifestyle management strategies to prevent / manage common hypokinetic diseases and disorders - Obesity - Cardiovascular diseases (e.g., coronary artery disease, hypertension) - Diabetes - Osteoporosis - Musculoskeletal disorders (e.g., osteoarthritis, Low back pain, Kyphosis, lordosis , flat foot, Knock knee) Meaning, Aims and objectives of yoga - Classification and importance of of Yogic Asanas (Sitting, Standing, lying) Pranayama and Its Types - Active Lifestyle and Stress Management Through Yoga Understanding on substance abuse and addiction - Psychoactive substances & its ill effects- Alcohol- Opioids- Cannabis -Sedative - Cocaine -Other stimulants, including caffeine -Hallucinogens - Tobacco -Volatile solvents.	4

4	First aid and principles of First Aid: Primary survey: ABC (Airway, Breathing, Circulation). Qualities of a Good First Aider First aid measures for: - Cuts and scrapes - Bruises - Sprains - Strains - Fractures - Burns - Nosebleeds. First Aid Procedures: Cardiopulmonary Resuscitation (CPR) - Heimlich Maneuver - Applying a sling Sports injuries: Classification (Soft Tissue Injuries - Abrasion, Contusion, Laceration, Incision, Sprain & Strain)	2

Additional Topics

- Need and Importance of Physical Education and its relevance in interdisciplinary context. Understanding of the Endocrine System
- Developing a fitness profile
- Healthy food habits for prevention and progression of Lifestyle Diseases. Processed foods and unhealthy eating habits.
- Depression - Anxiety - Stress
- Different ways of carrying an injured person. Usage of Automated external defibrillator

Course Assessment Method(CIE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Case Study/Micro project/Presentation	Activity evaluation	Total
10	20	20	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the different human body systems and describe various types of physical activities along with methods to measure and quantify these activities.	K2
CO2	Explain how to maintain or improve health and wellness through psychological practices, dietary habits, and sports activities.	K2
CO3	Discuss about common hypokinetic disorders and musculoskeletal disorders, and describe the importance of leading a healthy lifestyle through the practice of yoga and abstaining from addictive substances.	K2
CO4	Explain the basics of first aid and describe common sports injuries	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				2		3		3	3	2	2
CO2				2		3		2	2		2
CO3				0		3		3			2
CO4				2		3					2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Foundations of Nutrition	Bhavana Sabarwal	Common wealth Publishers	1999
2	Anatomy and physiology in health and illness.	Ross and Wilson	Waugh, A., & Grant, A.	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fit to be Well Essential Concept	Thygerson, A. L., Thygerson, S. M., & Thygerson, J. S.	Jones & Bartlett Learning.	2018
2	Introduction to physical education, fitness, and sport.	Siedentop, D., & Van der Mars, H.	Human kinetics.	2022
3	Substance Use Disorders. Manual for Physicians.	Lal, R., & Ambekar, A	National Drug Dependence Treatment Centre, New Delhi	2005
4	The exercise health connection-how to reduce your risk of disease and other illnesses by making exercise your medicine.	Nieman, D. C., & White, J. A	Public Health	1998
5	ACSM's resource manual for guidelines for exercise testing and prescription.	Lippincott Williams & Wilkins.	American College of Sports Medicine.	2012
6	Exercise Physiology: energy, nutrition and human performance.	Katch, F. I., Katch, V. L., & McArdle, W. D.	Lippincott Williams & Wilkins	2010

Continuous Internal Evaluation Marks (CIE): for the Health and wellness course

Students will be evaluated as follows.

Title	Method of Evaluation
Attendance	Students must attend at least 75% of both theory and practical classes. They will receive 10 marks based on their class attendance. Students who do not meet the minimum attendance requirement for a course, as specified in the B. Tech regulations, will not be eligible to proceed to the next criteria.
Assignment / Presentation	Assignments will be given to students to assess their understanding of the subjects taught. Students will be required to make presentations on the subjects taught in class, and their understanding of the subjects will be assessed. Based on the Assignments and Presentations the students will be awarded marks out of 20

Activity Evaluation	The Assignment / Presentation faculty handling the class will use the tests from the Fitness Protocols and Guidelines for ages 18+ to 65 years, as set forth by FIT India. Measurements will be taken for all the tests of the FIT India Fitness Protocol and the evaluation will be based on the benchmark score received for the following tests: 1. V Sit Reach Test 2. Partial Curl Up - 30 seconds 3. Push Ups (Male) and Modified Push Up (Female) 4. Two (2) Km Run/Walk Students who achieve a total benchmark score of 8 across the aforementioned 4 tests will be awarded pass marks for activity evaluation. Students who score better will be awarded a maximum mark of 20.
Activity Evaluation - Special Circumstances	Physically challenged and medically unfit students can opt for an objective test to demonstrate their knowledge of the subjects taught. Based on their performance in the objective test, they will be awarded marks out of 20.
Activity Evaluation - Special Considerations NCC	Students who enrolled themselves in the NCC during the course period (between the start and end dates of the program) and attended 5 college level parades will be awarded pass marks for activity evaluation. Students who attend more parades will be eligible for a maximum mark of 20 based on their parade attendance.

Tests to evaluated as per Criterion - 2 and Benchmark

Scores V Sit Reach Test

How to Perform:

1. The subject removes their shoes and sits on the floor with the measuring line between their legs and the soles of their feet placed immediately behind the baseline, heels 8-12" apart.
2. The thumbs are clasped so that hands are together, palms facing down and placed on the measuring line.

3. With the legs held flat by a partner, the subject slowly reaches forward as far as possible, keeping the fingers on baseline and feet flexed.
4. After three tries, the student holds the fourth reach for three seconds while that distance is recorded.
5. Make sure there are no jerky movements, and that the fingertips remain level and the legs flat.

Infrastructure/Equipment Required:

1. A tape for marking the ground, marker pen, and ruler.
2. With the tape mark a straight line two feet long on the floor as the baseline, and a measurement line perpendicular to the midpoint of the baseline extending two feet on each side.
3. Use the marker pen to indicate every centimeter and millimeter along the measurement line. The point where the baseline and the measuring line intersect is the zero point.

Scoring: The score is recorded in centimeters and millimeters as the distance reached by the hand, which is the difference between the zero point (where the baseline and measuring line intersect) and the final position.

Scoring for V Sit Reach Test for Males

Level	Benchmark Score	Measurement (cm)
1	2	<11
2	4	12-13
3	6	14-17
4	7	18-19
5	8	20-21
6	9	22
7	10	>22

Scoring for V Sit Reach Test for Females

Level	Benchmark Score	Measurement (cm)
1	2	<14
2	4	15-16
3	6	17-19
4	7	20-21
5	8	22
6	9	23
7	10	>23

Partial Curl Up - 30 seconds

How to Perform:

1. The subject lies on a cushioned, flat, clean surface with knees flexed, usually at 90 degrees, with hands straight on the sides (palms facing downwards) closer to the ground, parallel to the body.
2. The subject raises the trunk in a smooth motion, keeping the arms in position, curling up the desired amount (at least 6 inches above/along the ground towards the parallel strip).
3. The trunk is lowered back to the floor so that the shoulder blades or upper back touch the floor.

Infrastructure/Equipment Required:

Flat clean cushioned surface with two parallel strips (6 inches apart),

Stopwatch Scoring: Record the maximum number of Curl ups in a certain time period 30 seconds.

Scoring for Partial Curl Up - 30 seconds Test for Males

Level	Benchmark Score	Numbers
1	2	<25
2	4	25-30
3	6	31-34
4	7	35-38
5	8	39-43
6	9	44-49
7	10	>49

Scoring for Partial Curl Up - 30 seconds Test for Females

Level	Benchmark Score	Numbers
1	2	<18
2	4	18-24
3	6	25-28
4	7	29-32
5	8	33-36
6	9	37-43
7	10	>43

Push Ups for Male/Modified Push Ups for Female How to Perform:

1. A standard push up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder width apart, extended and at a right angle to the body.
2. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch some other object, or until there is a 90-degree angle at the elbows, then returns back to the starting position with the arms extended.
3. This action is repeated, and the test continues until exhaustion, or until they can do no more in rhythm or have reached the target number of push-ups.
4. For Female: push-up technique is with the knees resting on the ground.

Infrastructure/Equipment Required:

Flat clean cushioned surface/Gym mat

Scoring: Record number of correctly completed pushups.

Scoring for Push Ups for Male

Level	Benchmark Score	Numbers
1	2	<4
2	4	04- 10
3	6	11 -18
4	7	19-34
5	8	35-46
6	9	47-56
7	10	>56

Scoring for Modified Push Ups for Female

Level	Benchmark Score	Numbers
1	2	0-1
2	4	2 - 5
3	6	6 -10
4	7	11 - 20
5	8	21-27
6	9	27-35
7	10	>35

2 Km Run/Walk

How to Perform:

1. Participants are instructed to run or walk 2 kms in the fastest possible pace.
2. The participants begin on signal (Starting point)- “ready, start”. As they cross the finish line, elapsed time should be announced to the participants.
3. Walking is permitted but the objective is to cover the distance in the shortest possible time.

Infrastructure/Equipment Required:

Stopwatch, whistle, marker cone, lime powder, measuring tape, 200 or 400 m with 1.22 m (minimum 1 m) width preferably on a flat and even playground with a marking of starting and finish line. You can also use any application on your mobile phone that tells you the distance.

Scoring: Time taken for completion (Run or Walk) in min, sec.

Scoring for 2Km Run/walk for Male

Level	Benchmark Score	Minutes: Seconds
1	2	> 11:50
2	4	10:42
3	6	09:44
4	7	08:59
5	8	08:33
6	9	07:37
7	10	>07:37

Scoring for 2Km Run/walk for Female

Level	Benchmark Score	Minutes: Seconds
1	2	>13:47
2	4	12:51
3	6	12:00
4	7	11:34
5	8	10:42
6	9	09:45
7	10	>09:45

SEMESTER - S1/S2
LIFE SKILLS AND PROFESSIONAL COMMUNICATION

(Common to all Branches)

Course Code	UCHUT128	CIE Marks	100
Teaching Hours/Week (L: T:P: R)	2:0:1:0	ESE Marks	0
Credits	1	Exam Hours	-
Prerequisites (if any)	None	Course Type	Activity-based learning

Course objectives:

1. To foster self-awareness and personal growth, enhance communication and interpersonal connection skills, promote effective participation in groups and teams, develop critical thinking, problem-solving, and decision-making skills, and cultivate the ability to exercise emotional intelligence.
2. To equip students with the necessary skills to listen, read, write & speak, to comprehend and successfully convey any idea, technical or otherwise
3. To equip students to build their profile in line with the professional requirements and standards.

Continuous Internal Evaluation Marks (CIE):

- Continuous internal evaluation is based on the individual and group activities as detailed in the activity table given below.
- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. They should use online collaboration tools for group activities, report/presentation making and work management.
- Activities are to be distributed between 3 class hours (2L+1P) and 3.5 Self-study hours.
- Marks given against each activity should be awarded fully if the students successfully complete the activity.
- Students should maintain a portfolio file with all the reports and other textual materials generated from the activities. Students should also keep a journal related to the activities undertaken.

- Portfolio and journal are mandatory requirements for passing the course, in addition to the minimum marks required.
- The portfolio and journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through the HMC courses and Mini project course.
- Self-reflection questionnaire shall be given at the beginning of the semester, in between and at the end of the semester based on the guidelines in the manual of the course.

Sl. No.	Activity	Class room (L) / Self Study (SS)	Week of completion	Group / Individual (G/I)	Marks	Skills	CO
1.1	Group formation and self-introduction among the group members	L	1	G	-	• Connecting with group members • Time management - Gantt Chart	
1.2	Familiarizing the activities and preparation of the time plan for the activities	L	1	G	-		
1.3	Preparation of Gantt chart based on the time plan	SS	1	G	2		
2.1	Take an online personality development test, self reflect and report	SS	1	I	2	• Self-awareness Writing	CO1
2.2	Role-storming exercise 1: Students assume 2 different roles given below and write about their • Strengths, • Areas for improvement, • Concerns, • Areas in which he/she hesitates to take advice, • Goals/Expectations, from the point of view of the following assumed roles i) their parent/guardian/mentor ii) their friend/sibling/cousin	L	1	I	2	• Goal setting - Identification of skills and setting goal • Self-awareness • Discussion in groups • Group work- Compiling of ideas • Mind mapping	CO1
2.3	Role-storming exercise 2: Students assume the role of their teacher and write about the • Skills required as a B.Tech graduate • Attitudes, habits, approaches required	SS	1	I	2		CO1

	and activities to be practised during their B.Tech years, in order to achieve the set goals						
2.4	Discuss the skills identified through role storming exercise by each one within their own group and improvise the list of skills	L	1	G	2		CO1
2.5	Prepare a mind map based on the role-storming exercise and exhibit/present it in class	SS	2	G	2		CO1
3	Prepare a presentation on instances of empathy they have observed in their own life or in other's life	L	2 to 4	I	2	• Empathy	CO2
4.1	Each student connects and networks with a minimum of 3 professionals from industry/public sector organizations/other agencies/NGOs /academia (atleast 1 through LinkedIn)	SS	3	I	2	• Workplace awareness • Listening • Communication - interacting with people • Networking through various media including LinkedIn • Discussion in groups • Report preparation • Creativity Goal setting - Preparation of action plan	
4.2	Interact with them to understand their workplace details including • workplace skills required • their work experience • activities they have done to enhance their employability during their B.Tech years • suggestions on the different activities to be done during B.Tech years Prepare a documentation of this	SS	3	I	4		CO2
4.3	Discuss the different workplace details & work readiness activities assimilated by each through the interactions within their group and compile the inputs collected by the individuals Prepare the Minutes of the discussions	SS	3	G	2		CO2
4.4	Report preparation based on the discussions	SS	4	G	3		CO4
4.5	Perform a role-play based on the workplace dynamics assimilated through interactions and group discussions	L	5	G	4		CO3
4.6	Identify their own goal and prepare an action plan for their undergraduate	SS	5	I	2		CO1

	journey to achieve the goal						
5.1	Select a real-life problem that requires a technical solution and list the study materials needed	L	6	G	2		CO3
5.2	Listen to TED talks & video lectures from renowned Universities related to the problem and prepare a one-page summary (Each group member should select a different resource)	SS	6	I	2		CO4
5.3	Use any online tech forum to gather ideas for solving the problem chosen	SS	6	G	2		CO5
5.4	Arrive at a possible solution using six thinking hat exercise	L	7	G	3		CO3
5.5	Prepare a report based on the problem-solving experience	SS	7	G	2		CO4
6.1	Linkedin profile creation	SS	1	I	2	Profile-building	CO6
6.2	Resume preparation	SS	8	I	2		CO6
6.3	Self introduction video	SS	8	I	3		CO6
7	Prepare a presentation on instances of demonstration of emotional intelligence	SS	9	I	2	Emotional intelligence	CO2
8	Prepare a short video presentation on diversity aspects observed in our society (3 to 5 minutes)	SS	10	G	3	Diversity	CO2, CO5
9	Take online Interview skills development sessions like robotic interviews; self-reflect and report	SS	10	I	2	• Interview skills	CO6
10	Take an online listening test, self reflect and report	SS	11	I	2	Listening skills	CO6
11.1	Activities to improve English vocabulary of students	L	8	I/G	4	• English vocabulary • English language skills • Writing • Presentation • Group work • Self-reflection	CO4
11.2	Activities to help students identify errors in English language usage	L	9	I/G	2		CO4
11.3	Activity to help students identify commonly misspelled words, commonly mispronounced words and confusing words	L	10	I/G	2		CO4
11.4	Write a self-reflection report on the improvement in English language communication through this course	SS	12	I	2		CO4
11.5	Presentation by groups on the						CO4, CO5

	experience of using online collaboration tools in various group activities and time management experience as per the Gantt chart prepared	L	11 to 12	G	2		

12.1	Each group prepares video content for podcasts on innovative technological interventions/research work tried out in Kerala context by academicians/professionals/Govt. agencies/research institutions/private agencies/NGOs/other agencies	SS	12	G	4	• Audio-visual presentations creations with the use of technology tools • Effective use of social media platforms • Profile building	CO2, CO4, CO5
12.2	Upload the video content to podcasting platforms or YouTube	SS	12	G	1		CO5
12.3	Add the link of the podcast in their LinkedIn profile	SS	12	G	1		CO5

Table 2. Lab hour Activities (P): 24 Marks

Sl No	Activity	Marks	Skill	CO
1	Hands-on sessions on day-to-day engineering skills and a self-reflection report on the experience gained: 1. Drilling practice using electric hand drilling machines. 2. Cutting of MS rod and flat using electric hand cutters. 3. Filing, finishing and smoothening using electrically operated hand grinders. 4. MS rod cutting using Hack saw by holding the work in bench wise. 5. Study and handling different types of measuring instruments. 6. Welding of MS, SS work pieces. 7. Pipe bending practice (PVC and GI). 8. Water tap fitting. 9. Water taps rubber seal changing practice. 10. Union and valves connection practice in pipes. 11. Foot valve fitting practice. 12. Water pump seal and bearing changing practice.	24	Basic practical engineering skills	3
2	Language Lab sessions	-	Language Skills	4

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to know & understand oneself, show confidence in one's potential & capabilities, set goals and develop plans to accomplish tasks	K5
CO2	Develop the ability to communicate and connect with others, participate in groups/teams, empathise, respect diversity, be responsible and understand the need to exercise emotional intelligence	K5
CO3	Develop thinking skills, problem-solving and decision-making skills	K5
CO4	Develop listening, reading, writing & speaking skills, ability to comprehend & successfully convey any idea, and ability to analyze, interpret & effectively summarize textual, audio & visual content	K6
CO5	Develop the ability to create effective presentations through audio-visual mediums with the use of technology tools and initiate effective use of social media platforms & tech forums for content delivery and discussions	K6
CO6	Initiate profile-building exercises in line with the professional requirements, and start networking with professionals/academicians	K6

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1										1	3
CO2					1			3		3	3
CO3		1	1		1					1	1
CO4					1					1	2
CO5					1	1				1	2
CO6					1					1	

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Life Skills & Personality Development	Maithry Shinde et.al.	Cambridge University Press	First Edition, 2022
2	Emotional Intelligence: Why it can matter more than IQ	Daniel Goleman	Bloomsbury, Publishing PLC	25th Anniversary Edition December 2020
3	Think Faster, Talk Smarter: How to speak successfully when you are put on the spot	Matt Abrahams	Macmillan Business	September 2023
4	Deep Work: Rules for focused success in a distracted world	Cal Newport	PIATKUS	January 2016
5	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Life Skills for Engineers	Remesh S., Vishnu R.G.	Ridhima Publications	First Edition, 2016
2	Soft Skills & Employability Skills	Sabina Pillai and Agna Fernandez	Cambridge University Press	First Edition, 2018
3	Effective Technical Communication	Ashraf Rizvi	McGraw Hill Education	2nd Edition 2017
4	English Grammar in Use	Raymond Murphy,	Cambridge University Press India PVT LTD	5th Edition 2023
5	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York	2004

SEMESTER S2

IT WORKSHOP

(Common to Group A&B)

Course Code	GXESL208	CIE Marks	50
Teaching Hours/Week(L: T:P: R)	0:0:2:0	ESE Marks	50
Credits	1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To provide a basic understanding about computer hardware, software, and computer network.
2. To familiarize the learner with the web development process using HTML, CSS, and Javascript.

Details of Experiments

Expt. No	Experiment (Minimum 10 Experiments)
1	Practice Computer Hardware – Familiarization CPU Box, Motherboard, CPU & Chip-set, Interface cards, Card slots, Hard disk, Cables, SMPS, NIC, Various ports, etc. Computer Peripherals - I/O Devices. Storage devices, Interface cards – Buses – Firmware
2	Familiarization of Boot process
3	Familiarizing installation of Linux and Windows operating systems
4	Familiarizing basic Unix/Linux commands - ls, mkdir, cp, mv, grep, rmdir, chmod, useradd, passwd, history, dmesg, cpuinfo, uname, du, time, write, fdisk
5	Familiarizing networking hardware - RJ45, UTP, fibre, switch, NIC, router, Wireless Access Point (WAP), modem
6	Familiarizing basic networking commands - ifconfig, ping, traceroute, nslookup, ssh, scp, telnet, ftp
7	View network traffic using Wireshark/Packet tracer

8	Familiarizing the steps how to configure and establishing a network connecting
9	Shell programming in Linux(bash)
10	Create a web page and deploy on a local web server.
11	Use Javascript to validate forms.
12	Create an image slider using HTML, CSS, and JavaScript. Allow users to navigate between images using previous and next buttons.
13	Familiarisation of LaTeX - Basic only
14	Familiarisation of Development Environments - Visual studio code, Sublime Text, Atom
15	Introducing Repositories - Git / Bitbucket

Course Assessment Method
(CIE: 50 Marks, ESE: 50 Marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work, experiments, Viva and Timely completion of Lab Reports / Record. (Continuous Assessment)	Internal Exam	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Mandatory requirements for ESE:

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Experiment with the fundamental hardware components of a computer and how to interface them with software systems.	K3
CO2	Make use of the command line of Linux operating system and shell programming.	K3
CO3	Experiment with the data network communication scenarios using Wireshark.	K3
CO4	Develop basic websites using HTML, CSS & JavaScript and manage the versions.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3		3						3
CO2	3	3	3	3	3						3
CO3	3	3	3	3	3						3
CO4	3	3	3	3	3						3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), : No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Invitation to ComputerScience	G. Michael Schneider, Judith Gersting	Cengage	2/e, 2020
2	LINUX for Developers: Jumpstart Your LinuxProgramming Skills	William Rothwell	Pearson	1/e, 2018
3	HTML, CSS, and JavaScript -All in One, Sams Teach Yourself	Julie C. Meloni Jennifer Kyrnin	Pearson	1/e, 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach	Irv Englander	Wiley	5/e, 2014
2	Mastering Git : Attain expertlevel proficiency with Git forenhanced productivity and efficient collaboration	Jakub Narębski	Packt	1/e, 2016
3	Web Design with HTML, CSS, JavaScript, and Jquery.	Jon Duckett	Wiley	1/e, 2014

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://overthewire.org/wargames/bandit/
2	https://www.w3schools.com/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

PROGRAMME CORE 1

SEMESTER S2

DISCRETE MATHEMATICS

(Common to all Computer Science and its allied branches)

Course Code	PCCST205	CIE Marks	40
Teaching Hours/Week(L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To equip students with the ability to analyze and solve problems using discrete mathematical techniques.
2. To give a deeper understanding of mathematical logic, set theory, and proof techniques such as direct proofs, proof by contradiction, and mathematical induction.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Sets, Functions, and Relations Sets and Subsets, Venn Diagrams, Set Operations, Set Identities, Generalized Unions and Intersections, The Principle of Inclusion-Exclusion (Basic and Generalized versions), and applications. Function definition, Injections, Surjections and Bijections, Inverse Functions, and Compositions of Functions, Cardinality of Sets, Cantor diagonalization argument Relations and Their Properties, Composition of relations, n-ary Relations, Representing Relations Using Matrices, Equivalence Relations, Equivalence Classes, Partial Orderings, Hasse Diagrams, Maximal and Minimal Elements, Lattices	11

2	Mathematical logic and proofs Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference Introduction to Proofs, Methods of Proving Theorems - Direct proof, Indirect proof (Proof by Contraposition), Proof by Contradiction, Proof by counter examples, The Pigeonhole Principle.	11
3	Induction and Recurrences Mathematical Induction, Weak and Strong induction Recursive (Inductive) definitions and recurrence relations, Modeling with Recurrence Relations, Solving Linear Recurrence Relations (homogeneous and nonhomogeneous), Generating Functions, Using Generating Functions to Solve Recurrence Relations.	11
4	Group theory Groups - Definition, Examples, and Elementary Properties, Abelian group, Permutation group, Subgroup, Homomorphisms, Isomorphisms, and Cyclic Groups, Cosets and Lagrange's Theorem	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions.

Part A	Part B	Total
- Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 = 24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Check the validity of predicates in Propositional and Quantified Propositional Logic using truth tables, deductive reasoning and inference theory on Propositional Logic	K3
CO2	Solve counting problems by applying the elementary counting techniques - Rule of Sum, Rule of Product, Permutation, Combination, Binomial Theorem, Pigeonhole Principle and Principle of Inclusion and Exclusion.	K3
CO3	Classify binary relations into various types and illustrate an application for each type of binary relation, in Computer Science.	K2
CO4	Illustrate an application for Partially Ordered Sets and Complete Lattices, in Computer Science	K3
CO5	Explain Generating Functions and solve First Order and Second Order Linear Recurrence Relations with Constant Coefficients	K3
CO6	Illustrate the abstract algebraic systems - Semigroups, Monoids, Groups, Homomorphism and Isomorphism of Monoids and Groups.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3							2
CO2	3	3	3	3							2
CO3	3	3	3	3							2

CO4	3	3	3	3							2
CO5	3	3	3	3							2
CO6	3	3	3	3							2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Discrete Mathematics and its Applications	Kenneth H. Rosen, Kamala Krithivasan	McGraw Hill	8/e, 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Schaum's Outline of Discrete Mathematics	Marc Lipson, Seymour Lipschutz	McGraw-Hill	3/e, 2021
2	Discrete Mathematics	Kenneth A. Ross, Charles R.B. Wright	Pearson	5/e, 2012

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptelvideos.com/lecture.php?id=6033
2	https://nptelvideos.com/lecture.php?id=6024
3	https://nptelvideos.com/lecture.php?id=6051
4	https://nptelvideos.com/lecture.php?id=6058

SEMESTER S2
DISCRETE MATHEMATICAL STRUCTURES
 (INFORMATION TECHNOLOGY)

Course Code	PCITT205	CIE Marks	40
Teaching Hours/Week(L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	A sound background in higher secondary school Mathematics	Course Type	Theory

Course Objectives:

1. Students will be able to understand and apply mathematical notations and concepts essential for computing.
2. Students can develop and utilize mathematical reasoning and proof strategies to enhance their analytical thinking and creative problem-solving skills.

SYLLABUS

Module No.	Syllabus Description	Contact Hours (44 Hrs)
1	Introduction to Logic: Propositional Logic, Truth tables, Conditional propositions and Logical Equivalence, The laws of Logic, The Principle of Duality, Resolution proofs. Predicates and Quantifiers: Universal quantifier and Existential quantifier, Negation of Quantifiers, The Rule of Universal Specification, The Rule of Universal Generalizations. The implications of Quantifiers.	11
2	Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations, The Binomial Theorem (without proof), Combinations with Repetition, Pigeon Hole Principle, Principle of Inclusion and Exclusion (without proof), Derangements.	11

3	Relations, Functions and Algebraic Structures: Sets, Relations, Functions, Equivalence Relations, Posets and Lattices, HasseDiagrams, Complimented and Distributive lattices, Structured sets for binary operations, Semigroups, Monoids, Groups, Rings, Fields.	12
4	Generating Function: Definitions and Examples, Calculation Techniques, Exponential Generating Function. Recurrence Relations: First-order linear recurrence relations with constant coefficients – homogeneous, non-homogeneous Solution. Second-order linear recurrence relations with constant coefficients, homogeneous, non-homogeneous Solution.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions		
Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply logical reasoning and formal methods to construct and verify logical arguments and proofs involving propositions, truth tables, logical equivalence, and quantifiers.	K3
CO2	Apply fundamental counting principles, including permutations, combinations, and the pigeonhole principle, to solve problems related to combinatorial analysis and discrete structures.	K3
CO3	Describe the concepts of sets, relations, and functions, and recognize the properties and structures of algebraic systems such as lattices, semigroups, monoids, groups, rings, and fields.	K2
CO4	Explain the concepts of sets, relations, functions, algebraic structures such as groups and fields, and the methods for solving first and second-order linear recurrence relations using generating functions and other techniques.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	-	-	-	-	-	-	2
CO2	3	2	2	1	-	-	-	-	-	-	2
CO3	3	2	2	1	-	-	-	-	-	-	2
CO4	3	2	2	1	-	-	-	-	-	-	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Discrete and Combinatorial Mathematics: An Applied Introduction	Ralph P. Grimaldi, B. V. Ramana	Pearson	5 th Edition, 2007.
2	Discrete Mathematics with Graph Theory and Combinatorics.	T Veerarajan	Tata McGraw Hill	1 st Edition, 2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Discrete Mathematics and its Applications	K. H. Rosen	McGraw Hill	7 th Edition, 2012
2	Discrete Mathematical Structures	D. S. Chandrasekharaiah	PRISM Books	4 th Edition, 2012
3	Discrete Mathematical Structures with Application to Computer Science	J. P. Tremblay and R. Manohar	Tata McGraw Hill	2 nd Edition, 2002
4	Discrete Mathematics for Computer Scientists & Mathematicians	Joe L. Mott, Abraham Kandel and Theodore P. Baker	Pearson Education	2nd Edition, 2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106106094
2	https://nptel.ac.in/courses/106103205
3	https://nptel.ac.in/courses/106106094
4	https://nptel.ac.in/courses/106103205

SEMESTER 3

**COMPUTER SCIENCE AND ENGINEERING
CYBER SECURITY**

MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-3

Course Code	25MAT301	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic calculus	Course Type	Theory

Course Objectives:

1. To familiarize students with the foundations of probability and analysis of random processes used in various applications in engineering and science.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, the Binomial probability distribution, the Poisson probability distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. [Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]	9
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. [Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1, 5.2]	9
3	Limit theorems: Markov's Inequality, Chebyshev's Inequality, Strong Law of Large Numbers (Without proof), Central Limit Theorem (without proof), Stochastic Processes: Discrete-time process, Continuous-time process, Counting Processes, The Poisson Process, Interarrival times (Theorems without proof) [Text 2: Relevant topics from sections 2.7, 2.9, 5.3]	9

4	Markov Chains, Random Walk Model, Chapman–Kolmogorov Equations, Classification of States, Irreducible Markov chain, Recurrent state, Transient state, Long-Run Proportions. (Theorems without proof) [Text 2: Relevant topics from sections 4.1, 4.2, 4.3, 4.4]	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	K3
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	K3
CO3	Familiarize and apply limit theorems and to understand the fundamental characteristics of stochastic processes.	K3
CO4	Solve problems involving Markov Chains, to understand their theoretical foundations and to apply them to model and predict the behaviour of various stochastic processes.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	-	-	-	-	-	-	2
CO2	3	3	-	2	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	2
CO4	3	3	-	2	-	-	-	-	-	-	-	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Probability and Statistics for Engineering and the Sciences	Devore J. L	Cengage Learning	9 th edition, 2016
2	Introduction to Probability Models	Sheldon M. Ross	Academic Press	13 th edition, 2024

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Probability and Random Processes for Electrical and Computer Engineers	John A. Gubner	Cambridge University Press	2012
2	Probability Models for Computer Science	Sheldon M. Ross	Academic Press	1 st edition, 2001
3	Probability, Random Variables and Stochastic Processes	Papoulis, A. & Pillai, S.U.,	Tata McGrawHill.	4 th edition, 2002
4	Probability, Statistics and Random Processes	Kousalya Pappu	Pearson	2013

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_mg31/preview
2	https://onlinecourses.nptel.ac.in/noc22_mg31/preview
3	https://archive.nptel.ac.in/courses/108/103/108103112/
4	https://archive.nptel.ac.in/courses/108/103/108103112/

SEMESTER S3**THEORY OF COMPUTATION**

(Common to CS/CA/CM/CD/CN/CC)

Course Code	25CST302	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CST205	Course Type	Theory

Course Objectives:

1. To introduce the concept of formal languages.
2. To discuss the Chomsky classification of formal languages with a discussion on grammar and automata for regular, context-free, context-sensitive, and unrestricted languages.
3. To discuss the notions of decidability and halting problem.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Foundations (Linz, Hopcroft) Motivation for studying computability, need for mathematical modeling - automata, Introducing automata through simple models - On/Off switch, coffee vending machine. Three basic concepts: Alphabet, Strings, and Languages Finite Automata (Linz, Hopcroft) Formal definition of a finite automaton, Deterministic Finite Automata (DFA), Regular languages, Nondeterminism (guess and verify paradigm), Formal definition of a nondeterministic finite automaton, NFA with epsilon transitions, Eliminating epsilon transitions (Proof not expected), Equivalence of NFAs and DFAs (Proof not expected) - The Subset Construction. DFA State Minimization, Applications of finite automata - text search, keyword recognition	11
2	Regular Expressions (Linz) The formal definition of a regular expression, Building Regular Expressions, Equivalence with finite automata (Proof not expected) -	

	Converting FA to Regular Expressions, Converting Regular Expressions to FA, Pattern Matching and Regular Expressions, Regular grammar, Equivalence with FA - Conversion in both directions Properties of Regular Languages (Linz) Closure and Decision Properties of Regular Languages (with proofs), The Pumping Lemma for Regular Languages (with formal proof), Pumping lemma as a tool to prove non regularity of languages Context-Free Grammars and Applications (Linz) Formal definition of a context-free grammar, Designing context-free grammars, Leftmost and Rightmost Derivations Using a Grammar, Parse Trees, Ambiguous Grammars, Resolving ambiguity, Inherent ambiguity, CFGs, and programming languages	11
3	Pushdown Automata (Linz) Formal definition of a pushdown automaton, DPDA and NPDA, Examples of pushdown automata Equivalence NPDAs and CFGs (Proof not expected) - conversions in both directions Simplification of Context-Free Languages (Linz) Elimination of useless symbols and productions, Eliminating epsilon productions, Eliminating unit productions, Chomsky normal form, Greibach normal form, Properties of Context-Free Languages (Linz) The Pumping Lemma for Context-Free Languages (with formal proof), Closure and Decision Properties of Context-Free Languages (with formal proofs)	11
4	Turing Machines (Kozen) The formal definition of a Turing machine, Examples of Turing machines - Turing machines as language acceptors, Turing machines as computers of functions, Variants of Turing Machines (Proofs for equivalence with basic model not expected), Recursive and recursively enumerable languages Chomskian hierarchy, Linear bounded automaton as a restricted TM. Computability (Kozen) Church Turing thesis, Encoding of TMs, Universal Machine and Diagonalization, Reductions, Decidable and Undecidable Problems, Halting problem, Post Correspondence Problem and the proofs for their undecidability.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)
Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Classify formal languages into regular, context-free, context-sensitive, and unrestricted languages.	K2
CO2	Design finite state automata, regular grammar, regular expression, and Myhill- Nerode relation representations for regular languages.	K3
CO3	Design push-down automata and context-free grammar representations for context-free languages.	K3
CO4	Design Turing Machines to accept recursive and recursively enumerable languages.	K3
CO5	Understand the notions of decidability and undecidability of problems, Halting problem.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	3	3	3	3								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	An Introduction to Formal Languages and Automata	Peter Linz and Susan H. Rodger	Jones and Bartlett Publishers, Inc	7/e, 2022
2	Introduction to Automata Theory Languages and Computation	John E.Hopcroft, Jeffrey D.Ullman	Rainbow Book Distributions	3/e, 2015
3	Automata and Computability	Dexter C. Kozen	Springer	1/e,2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to the Theory of Computation	Michael Sipser	Cengage India Private Limited	3/e, 2014
2	Introduction to Languages and the Theory of Computation	John C Martin	McGraw-Hill Education	4/e, 2010
3	Theory of Computation: A Problem-Solving Approach	Kavi Mahesh	Wiley	1/e, 2012
4	Elements of the Theory of Computation	Harry R. Lewis, Christos Papadimitriou	Pearson Education	2/e, 2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/104/106104148/ https://nptel.ac.in/courses/106106049
2	https://archive.nptel.ac.in/courses/106/104/106104148/ https://nptel.ac.in/courses/106106049
3	https://archive.nptel.ac.in/courses/106/104/106104148/ https://nptel.ac.in/courses/106106049
4	https://archive.nptel.ac.in/courses/106/104/106104148/ https://nptel.ac.in/courses/106106049

SEMESTER S3**DATA STRUCTURES AND ALGORITHMS**

(Common to CS/CA/CM/CD/CR/AI/AM/AD/CB/CN/CC/CU/CI/CG)

Course Code	25CST303	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST105	Course Type	Theory

Course Objectives:

1. To provide the learner a comprehensive understanding of data structures and algorithms.
2. To prepare them for advanced studies or professional work in computer science and related fields.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Concepts of Data Structures Definitions; Data Abstraction; Performance Analysis - Time & Space Complexity, Asymptotic Notations; Polynomial representation using Arrays, Sparse matrix (<i>Tuple representation</i>); Stacks and Queues - Stacks, Multi-Stacks, Queues, Circular Queues, Double Ended Queues; Evaluation of Expressions- Infix to Postfix, Evaluating Postfix Expressions.	11
2	Linked List and Memory Management Singly Linked List - Operations on Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List; Doubly Linked List; Circular Linked List; Memory allocation - First-fit, Best-fit, and Worst-fit allocation schemes; Garbage collection and compaction.	11
3	Trees and Graphs Trees :- Representation Of Trees; Binary Trees - Types and Properties, Binary Tree Representation, Tree Operations, Tree Traversals; Expression Trees; Binary Search Trees - Binary Search Tree Operations; Binary Heaps - Binary Heap Operations, Priority Queue. Graphs :- Definitions; Representation of Graphs; Depth First Search and	11

	Breadth First Search; Applications of Graphs - Single Source All Destination.	
4	Sorting and Searching Sorting Techniques :- Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Radix Sort. Searching Techniques: - Linear Search, Binary Search, Hashing - Hashing functions : Mid square, Division, Folding, Digit Analysis; Collision Resolution : Linear probing, Quadratic Probing, Double hashing, Open hashing.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify appropriate data structures for solving real world problems.	K3
CO2	Describe and implement linear data structures such as arrays, linked lists, stacks, and queues.	K3
CO3	Describe and Implement non linear data structures such as trees and graphs.	K3
CO4	Select appropriate searching and sorting algorithms to be used in specific circumstances.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities press,	2/e, 2007
2	Introduction to Algorithms	Thomas H Cormen, Charles Leisesrson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill.	2/e, 2017
4	Theory and Problems of Data Structures	Lipschuts S.	Schaum's Series	2/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106102064
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/

SEMESTER S3

BASIC CONCEPTS IN COMPUTER NETWORKS

Course Code	25CCZ304	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand and analyse the concepts of computer networking and its performance measures.
2. Understand the concepts of physical layer and data link layer
3. Understand important aspects and functions of network layer and various routing algorithms.
4. Understand and analyse the various transport and application layer protocols.
5. Acquire skill sets required for the development and deployment of networking applications

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	History of Computer Networks and the Internet , types of networks, Client-server and peer-to-peer architecture. Design issues for the layers – Interface & Service – Service Primitives. Reference models – OSI – TCP/IP. Concept of Quality of Service metrics - throughput, delay, packet loss, and jitter in packet-switched networks.	9
2	Physical layer design issues - Media, Signal strength and interference. Data encoding, Multiplexing (TDM, FDM). Data Link layer Design Issues – Flow Control and ARQ techniques. Data link Protocols – HDLC. IEEE 802 FOR LANs IEEE 802.3, 802.5. Wireless LANs - 802.11.	9

3	Networking devices - Bridges, Routers, Gateways, Network Layer Protocols - Virtual circuits and datagrams, Principles of routing, internet protocol Ipv4 CIDR, IPv6, Network Address Translation , Firewalls, and VPNs Routing algorithms - Link-state and distance vector routing, Routing on the internet RIP OSPF and BGP.	9
4	Introduction to transport layer, Multiplexing and de-multiplexing, Principles of Reliable data transfer – end-to - end flow control mechanisms, Connection oriented transport TCP, Connectionless transport UDP. Application layer protocols - HTTP and HTTPs, FTP, SMTP- S/MIME, DNS, and Peer-to-peer file sharing networks	9

Suggestion on Project Topics

Project: Installation and configuration of the LAMP stack. Design and develop a relevant web application using the LAMP stack. Deploy the web application project in a LAN with a server and clients with distinct IP addresses.

Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand and apply the concepts of computer networking and its performance measures.	K3
CO2	Understand the concepts of physical layer and data link layer	K2
CO3	Understand important aspects and functions of network layer and various routing algorithms	K2
CO4	Understand and analyse the various transport and application layer protocols.	K2
CO5	Acquire skill sets required for the development and deployment of networking applications	K6

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2			2					2
CO2	3	2	2			2	2					2
CO3	3	2	2				2					2
CO4	3	2	2			2	2					2
CO5	3	2	3	2	3	2	2	2	3	3	3	2

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks: A Top-Down Approach	Behrouz A. Forouzan and Firouz Mosharraf	Tata McGraw Hill Education Private Limited	First Edition 2023
2	Computer Networks-A Systems Approach	Larry L. Peterson & Bruce S. Dave	The Morgan Kaufmann Series in Networking	Sixth Edition, 2021
3	Computer Networks	Andrew S. Tanenbaum, Nick Feamster, David Wetherall	Pearson	Sixth Edition, 2021

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networking A Top-Down Approach	James F. Kurose and Keith W. Ross	Pearson	Seventh Edition, 2017
2	Computer Networking and the Internet	Fred Halsall	Pearson	Fifth Edition, 2006
3	The Illustrated Network: How TCP/IP Works in a Modern Network	Walter Goralski	Morgan Kaufmann	Second Edition, 2009
4	Networking All-in-One for Dummies	Doug Lowe	John Wiley & Sons	Seventh Edition, 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106105183
2	https://www.udemy.com/course/networkingbasics/
3	https://ubuntu.com/server/docs/get-started-with-lamp-applications

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S3
DIGITAL ELECTRONICS AND LOGIC DESIGN
(Common to Group A)

Course Code	25EST305	CIE Marks	40
Teaching Hours/Week (L:T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To familiarize the basic concepts of Boolean algebra and digital systems.
2. To enable the learner to design simple combinational and sequential logic circuits which is essential in understanding organization & design of computer systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to digital Systems :- Digital abstraction Number Systems – Binary, Hexadecimal, grouping bits, Base conversion; Binary Arithmetic – Addition and subtraction, Unsigned and Signed numbers; Fixed-Point Number Systems; Floating-Point Number Systems Basic gates- Operation of a Logic circuit; Buffer; Gates - Inverter, AND gate, OR gate, NOR gate, NAND gate, XOR gate, XNOR gate; Digital circuit operation - logic levels, output dc specifications, input dc specifications, noise margins, power supplies; Driving loads - driving other gates, resistive loads and LEDs.	11

	Verilog (Part 1) :- HDL Abstraction; Modern digital design flow - Verilog constructs: data types, the module, Verilog operators.	
2	Combinational Logic Design: – Boolean Algebra - Operations, Axioms, Theorems; Combinational logic analysis - Canonical SOP and POS, Minterm and Maxterm equivalence; Logic minimization - Algebraic minimization, K-map minimization, Don't cares, Code convertors. Modeling concurrent functionality in Verilog:- Continuous assignment - Continuous Assignment with logical operators, Continuous assignment with conditional operators, Continuous assignment with delay.	11
3	MSI Logic and Digital Building Blocks MSI logic - Decoders (One-Hot decoder, 7 segment display decoder), Encoders, Multiplexers, Demultiplexers; Digital Building Blocks - Arithmetic Circuits - Half adder, Full adder, half subtractor, full subtractor; Comparators. Structural design and hierarchy - lower-level module instantiation, gate level primitives, user defined primitives, adding delay to primitives.	8
4	Sequential Logic Design:- Latches and Flip-Flops- SR latch, SR latch with enable, JK flipflop, D flipflop, Register Enabled Flip-Flop, Resettable Flip-Flop. Sequential logic timing considerations; Common circuits based on sequential storage devices - toggle flop clock divider, asynchronous ripple counter, shift register. Finite State Machines:- Finite State Machines - logic synthesis for an FSM, FSM design process and design examples; Synchronous Sequential Circuits - Counters; Verilog (Part 2): - Procedural assignment; Conditional Programming constructs; Test benches; Modeling a D flipflop in Verilog; Modeling an FSM in Verilog.	14

Course Assessment Method
(CIE: 40 marks ESE:60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks. (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize the basic concept of different number systems and perform conversion and arithmetic operations between different bases.	K2
CO2	Interpret a combinational logic circuit to determine its logic expression, truth table, and timing information and to synthesize a minimal logic circuit through algebraic manipulation or with a Karnaugh map.	K2
CO3	Illustrate the fundamental role of hardware description languages in modern digital design and be able to develop the hardware models for different digital circuits.	K3
CO4	Develop MSI logic circuits using both the classical digital design approach and the modern HDL-based approach.	K3
CO5	Develop common circuits based on sequential storage devices including counter, shift registers and a finite state machine using the classical digital design approach and an HDL-based structural approach.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3								3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	3	3	3	3	3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Logic Circuits & Logic Design with Verilog	Brock J. LaMeres	Springer International Publishing	2/e, 2017
2	Digital Design and Computer Architecture - RISC-V Edition	Sarah L. Harris, David Harris	Morgan Kaufmann	1/e, 2022
Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog	M Morris Mano, Michael D Ciletti	Pearson	6/e, 2018
2	Digital Fundamentals	Thomas Floyd	Pearson	11/e, 2015
3	Fundamentals of Digital Logic with Verilog Design	Stephen Brown, Zvonko Vranesic	McGrawHill	3/e, 2014
4	Switching and Finite Automata Theory	Zvi Kohavi Niraj K. Jha	Cambridge University Press	3/e, 2010

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/117105080
2	https://onlinecourses.nptel.ac.in/noc21_ee39/
3	https://onlinecourses.nptel.ac.in/noc24_cs61/

SEMESTER S3/S4**ECONOMICS FOR ENGINEERS****(Common to all branches)**

Course Code	25HUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with an understanding of fundamental economic principles essential for effective decision-making in engineering contexts.
2. To enable students to apply economic analysis to production decisions, cost management, and market strategies in engineering practice.
3. To equip students with the ability to evaluate macroeconomic scenarios, financial methods, and investment decisions relevant to engineering projects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Demand: Factors determining demand – Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Law of supply – Supply curve- Equilibrium price determination- Changes in demand and supply and its effects on equilibrium price and quantity Production: Production function - Law of variable proportion –Returns to scale- Cobb-Douglas Production Function	6
2	Cost: Cost concepts – Private cost and social cost – Sunk cost – Opportunity cost -Explicit and implicit cost –Short run cost curves –Long run average cost curve -Revenue concepts – Break-even point Market: Perfect Competition – Monopoly - Monopolistic Competition (features and equilibrium of a firm) - Oligopoly – Features – Kinked demand model	6

3	National income: Concepts (GDP, GNP and NNP)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method-- Difficulties in the measurement of national income. Inflation: Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Repo and reverse repo rate	6
4	Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure Capital Budgeting: Time value of money - Net Present Value Method - Benefit Cost Ratio – Internal Rate of Return – Payback – Accounting Rate of Return.	6

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/Case Study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
- Minimum 1 and Maximum 2 Questions from each module. - Total of 6 Questions, each carrying 3 marks (6x3 =18 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems and national income.	K2
CO4	Make use of the possibilities of value analysis and engineering, and take investment decisions through capital budgeting techniques.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012
4	Financial Management	I M Pandey	Vikas Publishing House	2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001
5	Financial Management: Theory and Practice	Prasanna Chandra	Mc Graw Hill	2007

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	25HUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education,	6

	employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	
2	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	6
3	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	6
4	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental	6

	Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

Course Assessment Method
(CIE: 50 marks , ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarizing the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks				50

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.

- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero-waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyze the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyze a local infrastructure project for its climate resilience and suggest improvements.
- Analyze a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S3**DATA STRUCTURES LAB**

(Common to CS/CA/CM/CD/CR/AI/AM/AD/CB/CN/CC/CU/CI/CG)

Course Code	25CSL307	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST204	Course Type	Lab

Course Objectives :

1. To give practical experience for learners on implementing different linear and non linear data structures, and algorithms for searching and sorting.

Expt. No.	Experiments
1	Find the sum of two sparse polynomials using arrays
2	Find the transpose of a sparse matrix and sum of two sparse matrices.
3	Convert infix expression to postfix (or prefix) and then evaluate using stack,
4	Implement Queue, DEQUEUE, and Circular Queue using arrays.
5	Implement backward and forward navigation of visited web pages in a web browser (i.e. back and forward buttons) using doubly linked list operations.
6	Implement addition and multiplication of polynomials using singly linked lists.
7	Create a binary tree for a given simple arithmetic expression and find the prefix / postfix equivalent.
8	Implement a dictionary of word-meaning pairs using binary search trees.
9	Find the shortest distance of every cell from a landmine inside a maze.
10	We have three containers whose sizes are 10 litres, 7 litres, and 4 litres, respectively. The 7-litre and 4-litre containers start out full of water, but the 10-litre container is initially empty. We are allowed one type of operation: pouring the contents of one container into another, stopping only when the source container is empty or the destination container is full. We want to know if there is a sequence of pourings that leaves exactly 2 litres in the 7 or 4-litre container. Model this as a graph problem and solve.
11	Implement the find and replace feature in a text editor.

12	Given an array of sorted items, implement an efficient algorithm to search for specific item in the array.
13	Implement Bubble sort, Insertion Sort, Radix sort, Quick Sort, and Merge Sort and compare the number of steps involved.
14	The General post office wishes to give preferential treatment to its customers. They have identified the customer categories as Defence personnel, Differently abled, Senior citizen, Ordinary. The customers are to be given preference in the decreasing order - Differently abled, Senior citizen, Defence personnel, Normal person. Generate the possible sequence of completion.
15	Implement a spell checker using a hash table to store a dictionary of words for fast lookup. Implement functions to check if a word is valid and to suggest corrections for misspelled words.
16	Simulation of a basic memory allocator and garbage collector using doubly linked list
17	The CSE dept is organizing a tech fest with so many exciting events. By participating in an event, you can claim for activity points as stipulated by KTU. Each event i gives you $A[i]$ activity points where A is an array. If you are not allowed to participate in more than k events, what's the max number of points that you can earn?
18	Merge K sorted lists into a single sorted list using a heap. Use a min-heap to keep track of the smallest element from each list. Repeatedly extract the smallest element and insert the next element from the corresponding list into the heap until all lists are merged.

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Model a real world problem using suitable data structure and implement the solution.	K3
CO2	Compare efficiency of different data structures in terms of time and space complexity.	K4
CO3	Evaluate the time complexities of various searching and sorting algorithms.	K5
CO4	Differentiate static and dynamic data structures in terms of their advantages and application.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3				3				3
CO2	3	3	3	3				3				3
CO3	3	3	3	3				3				3
CO4	3	3	3	3				3				3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities Press,	2/e, 2007
2	Introduction to Algorithms	Thomas H Cormen, Charles Leiserson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003
3	Introduction to Data Structures with Applications	Tremblay J. P., P. G. Sorenson	Tata McGraw Hill.	2/e, 2017
4	Theory and Problems of Data Structures	Lipschutz S.	Schaum's Series	2/e, 2014

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://nptel.ac.in/courses/106102064
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S3

SHELL SCRIPTING AND NETWORK ADMINISTRATION USING LINUX

Course Code	25CCL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:2:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None / Course Code	Course Type	Lab

Course Objectives:

1. The course aims to master Shell Scripting and get hands-on exposure to network Administration.
2. The course aims to offer hands-on experience for learners in Python programming and use it for security implementations.
3. The course aims to offer exposure to Practical Application of Tools and Utilities.

Expt. No.	Experiments
1	Introduction of Linux and usage of terminal editors. Familiarity with following commands/operations expected 1. man 2. ls, echo, read 3. more, less, cat, 4. cd, mkdir, pwd, find 5. mv, cp, rm ,tar 6. wc, cut, paste 7. head, tail, grep, expr 8. chmod, chown 9. Redirections & Piping 10. useradd, usermod, userdel, passwd 11. df,top, ps 12 ssh, scp, ssh-keygen, ssh-copy-id
2	Study the following aspects of Shell scripting: bash syntax, environment variables, variables, control constructs such as if, for and while, aliases and functions, accessing command line arguments passed to shell scripts.
3	Study of startup scripts, login and logout scripts, familiarity with system d and system V init scripts expected.
4	a) Write a script to create a directory structure b) Implement a script to list all files and directories within a specified directory showing date of creation & serial number of file.

5	a) Write a script to automate a task (e.g., backup important files) and schedule it using cron. b) Create a script to clean up old log files periodically.
6	Write a script to monitor system resources such as CPU, memory, and disk usage and Implement a script to send an alert if resource usage exceeds a specified threshold.
7	a) Study of IPv4 networking, command line tools, and network commands, including ping, traceroute, nslookup, ip, nc, and tcpdump. b) Configuring IP addresses, both dynamic and static Subnet masks, CIDR address schemes. c) Study concepts of iptables, LAN firewall configuration, and application layer (L7) proxies
8	a) Write a script to ping a list of servers and log the results. b) Implement a script to check if a specific port is open on a remote server.
9	a) Write a script to automate common network troubleshooting commands b) Write a script to capture network packets using tcpdump
10	a) Write a script to start, stop, and restart network services (e.g., Apache, Nginx, MySQL) b) Implement a script to check the status of these services and restart them if they are not running.
11	a) Write a script to set up basic firewall rules using iptables or firewalld. b) Implement a script to allow or block specific IP addresses or ranges
12	Familiarizing Python- variables, decision statements, iteration statements, functions
13	Write a python program to check the strength of a password.
14	Write a Keylogger / key logger detection tool program using python
15	Write a python program to implement Primality testing using Miller-Rabin Method
16	Write a python program to implement pseudo-random number generation
17	Implement Client-Server communication using Socket Programming and TCP as transport layer protocol.
18	Implement Client-Server communication using Socket Programming and UDP as transport layer protocol.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarizing the basic Linux and networking commands/operations	K2
CO2	Illustrate the use of shell scripting in system and network administration	K3
CO3	Create scripts for directories and file structures	K3
CO4	Develop security related programs using python libraries	K3
CO5	Implement Client server communication using standard protocols	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	3										
CO3	3	3										
CO4	3	3										
CO5	3	3			3							

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Linux Command Line: A Complete Introduction	William E. Shotts Jr.	No Starch Press	Second Internet Edition
2	Learning the bash Shell: Unix Shell Programming"	Cameron Newham	O'Reilly Media	Third edition
3	Automate the Boring Stuff with Python	Al Sweigart	No Starch Press	Second edition

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	http://acl.digimat.in/nptel/courses/video/117106113/117106113.html
2	https://archive.nptel.ac.in/courses/106/106/106106212/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 4

**COMPUTER SCIENCE AND ENGINEERING
CYBER SECURITY**

SEMESTER S4**MATHEMATICS FOR COMPUTER AND INFORMATION SCIENCE-4**

Course Code	25MAT401	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NIL	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of fundamental concepts of graph theory including paths, cycles, trees, graph algorithms, graph coloring and matrix representations, emphasizing their applications across various disciplines.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Graphs - Basic definition, Application of graphs, finite and infinite graphs, Incidence and Degree, Isolated vertex, Pendant vertex and Null graph. Isomorphism, Sub graphs, Walks, Paths and circuits, Connected graphs, Disconnected graphs and components. [Text 1: Relevant topics from sections 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.4, 2.5. Proofs of theorems 2.5, 2.7 are excluded.]	9
2	Euler graphs, Operations on Graphs, Hamiltonian paths and circuits, Travelling Salesman Problem, Connectivity, Edge connectivity, Vertex connectivity, Directed graphs, Types of directed graphs. [Text 1: Relevant topics from sections 2.6, 2.7, 2.8, 2.9, 2.10, 4.1, 4.2, 4.5, 9.1, 9.2. Proofs of theorems 4.6, 4.11, 4.12 are excluded.]	9
3	Trees- properties, Pendant vertices, Distance and centres in a tree, Rooted and binary trees, Counting trees, Spanning trees, Prim's algorithm and Kruskal's algorithm, Dijkstra's shortest path algorithm, Floyd-Warshall	9

	shortest path algorithm. [Text 1: Relevant topics from sections 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.10, 11.5. Proofs of theorems 3.10, 3.16 are excluded.]	
4	Matrix representation of graphs- Adjacency matrix, Incidence Matrix, Circuit Matrix, Path Matrix, Coloring, Chromatic number, Chromatic polynomial, Greedy colouring algorithm. [Text 1: Relevant topics from sections 7.1, 7.3, 7.8, 7.9, 8.1, 8.3. Proofs of theorems 7.4, 7.7, 7.8, 8.2, 8.3, 8.5, 8.6 are excluded.]	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamental concepts of graph theory such as types of graphs, degree of a vertex, graph isomorphism, connectedness.	K2
CO2	Understand the concepts of Euler graphs, Hamiltonian graphs and connectivity.	K2
CO3	Apply Prim's and Kruskal's algorithms for finding minimum cost spanning tree and Dijkstra's and Floyd-Warshall algorithms for finding shortest paths.	K3
CO4	Illustrate various representations of graphs using matrices and apply vertex coloring in real life problems.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	-	-	-	-	-	-	-	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2
CO4	3	3	2	2	-	-	-	-	-	-	-	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Graph Theory with Applications to Engineering and Computer Science	Narsingh Deo	Prentice Hall India Learning Private Limited	1st edition, 1979

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Graph Theory 2e	Douglas B. West	Pearson Education India	2nd edition, 2015
2	Introduction to Graph Theory	Robin J. Wilson	Longman Group Ltd.	5th edition, 2010
3	Graph Theory with Applications	J.A. Bondy and U.S.R. Murty	Elsevier Science Publishing Co., Inc	1976

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc22_ma10/preview
2	https://onlinecourses.nptel.ac.in/noc22_ma10/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs48/preview
4	https://onlinecourses.nptel.ac.in/noc21_cs48/preview

SEMESTER S4**DATABASE MANAGEMENT SYSTEMS**

(Common to CS/CD/CA/CR/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	25CST402	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CST303	Course Type	Theory

Course Objectives:

1. Equip the students with a comprehensive understanding of fundamental DBMS concepts as well as the principles and applications of NoSQL databases
2. Enable students to design, implement, and manage both relational and NoSQL databases

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Databases :- Database System Concepts and Architecture- Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Centralized and Client/Server Architectures for DBMSs. Conceptual Data Modelling and Database Design :- Data Modelling Using the Entity, Relationship (ER) Model - Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types. Refining the ER Design for the COMPANY Database.	11
2	The Relational Data Model and SQL - The Relational Data Model and Relational Database Constraints-Relational Algebra and Relational Calculus - Structured Query Language (SQL)-Data Definition Language, Data Manipulation Language, Assertions, Triggers, views, Relational Database Design Using ER-to-Relational Mapping.	11
3	Database Design Theory & Normalization - Functional Dependencies - Basic definition; Normalization- First, Second, and Third normal forms. Transaction Management - Transaction Processing : Introduction, problems and	11

	failures in transaction, Desirable properties of transaction, Characterizing schedules based on recoverability and serializability; Concurrency Control with Two-Phase Locking Techniques- Database Recovery management: Deferred update-immediate update- shadow paging.	
4	Introduction To NoSQL Concepts - types of NoSQL databases- CAP Theorem- BASE properties- Use Cases and limitations of NoSQL. SQL architectural Patterns - Key value Stores, Graph Stores, Column Family stores and Document Stores.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarize and exemplify the fundamental nature and characteristics of database systems	K2
CO2	Model and design solutions for efficiently representing data using the relational model or non-relational model	K3
CO3	Discuss and compare the aspects of Concurrency Control and Recovery in Database systems	K3
CO4	Construct advanced SQL queries to effectively retrieve, filter, and manipulate data from relational databases.	K3
CO5	Experiment with NoSQL databases in real world applications	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3						2	2	3
CO3	3	3	3	3								3
CO4	3	3	3	3								3
CO5	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Database Systems [Module 1,2,3,4]	Elmasri, Navathe	Pearson	7/e,
2	Making the Sense of NoSQL : A guide for Managers and rest of us [Module 4]	Dan McCreary and Ann Kelly	Manning	2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A., H. F. Korth and S. Sudarshan, Database System Concepts,	Sliberschatz A., H. F. Korth and S. Sudarshan, Database System Concepts, 6/e, McGraw Hill, 2011.	McGraw Hill,	7/e, 2011
2	Beginning Database Design Solutions	Rod Stephens	Wiley	2/e, 2023
2	NoSQL Distilled	Pramod J. Sadalage, Martin Fowler	Addison-Wesley	1/e, 2012
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
4	https://archive.nptel.ac.in/courses/106/104/106104135/

SEMESTER S4
OPERATING SYSTEMS

(Common to CS/CD/CM/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	25CST403	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the structure of a typical operating system and its core functionalities
2. To impart to the students, a practical understanding of OS implementation nuances based on the Linux operating system

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Operating Systems (Book 1 Ch 2 introductory part), Operating System Services (Book 3 Ch 2) Overview of Operating Systems and Kernels, Linux Versus Classic Unix Kernels (Book 2 Ch 1) Process concepts: Process Creation, Process States, Data Structures, Process API (Book 1 Ch 4, 5), Sharing processor among processes - user and kernel modes, context switching (Book 1 Ch 6), System boot sequence (Book 3 Ch 2) Case study: <i>Linux kernel process management (Book 2, Ch 3)</i> Threads and Concurrency: Concept of a thread, Multithreading benefits, Multithreading models (Book 3 Ch 4) Case study: <i>The Linux Implementation of Threads (Book 2, Ch 3)</i> Process scheduling: Concepts and basic algorithms (Book 1 Ch 7), The Multilevel Feedback Queue: Basic Rules (Book 1 Ch 8) Case study: <i>The Linux Completely Fair Scheduler (CFS) (Book 1 Ch 9,</i>	11

	<i>Implementation with RB trees not required), The Linux Scheduling Implementation, Preemption and Context Switching (Book 2, Ch 4)</i>	
2	Concurrency and Synchronization - Basic principles (Book 3 Sections 6.1, 6.2), Mechanisms - Locks: The Basic Idea, Building Spin Locks with Test-And-Set, Compare and Swap, Using Queues: Sleeping Instead Of Spinning (Book 1 Ch 28), Semaphores - Definition, Binary Semaphores, The Producer/Consumer (Bounded Buffer) Problem and its solution using semaphores, Reader-Writer Locks (Book 1 Ch 31) Case study: <i>Linux Kernel Synchronization Methods - Spin Locks, Semaphores, Mutexes (Book 2 Ch 10)</i> Concurrency: Deadlock and Starvation - Deadlock Characterization, Deadlock Prevention and Avoidance, Deadlock Detection and recovery (Book 3 Ch 8), Dining Philosophers Problem and its solution (Book 1 Ch 31)	12
3	Memory management - Address Space, Memory API, Address Translation - An Example, Dynamic (Hardware-based) Relocation, Segmentation: Generalized Base/Bounds, Address translation in segmentation, Support for Sharing (Book 1 Ch 13 to 16) Virtual memory - Paging: Introduction, page tables and hardware support, TLBs, Example: Accessing An Array, - TLB hits and misses, Handling TLB misses, TLB structure, Reducing the page table size (Book 1 Ch 18 to 20) Going beyond physical memory - Swap space, page fault and its control flow, page replacement policies, Thrashing (Book 1 Ch 21, 22)	11
4	I/O system: Modern System architecture, Programmed I/O, Interrupts, DMA, Device interaction methods, The Device Driver (Book 1 Ch 36), Hard disk: Geometry (Book 1 Ch 37), disk scheduling (Book 3 Section 11.2) Case study: <i>Linux I/O schedulers - Elevator, Complete Fair Queuing (Book 2 Ch 14)</i> Files and Directories: The File System Interface - File descriptor, reading and writing files (sequential and random access), Removing files - Hard links and Symbolic links, Creating, reading and deleting directories, Permission	10

	bits and Access Control Lists, Mounting a file system (Book 1 Ch 39) File Organization: The Inode, The Multi-Level Index (Book 1 Ch 40) <i>Case study: VFS Objects and Their Data Structures - The Inode Object, Inode Operations (Book 2 Ch 13)</i>	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub-divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concepts of process management and process scheduling mechanisms employed in operating systems.	K3
CO2	Choose various process synchronization mechanisms employed in operating systems.	K3
CO3	Use deadlock prevention and avoidance mechanisms in operating systems.	K3
CO4	Select various memory management techniques in operating systems.	K3
CO5	Understand the storage management in operating systems.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3
CO5	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Operating Systems: Three Easy Pieces	Andrea Arpaci-Dusseau, Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018
3	Operating System Concepts	Abraham Silberschatz, Peter B. Galvin, Greg Gagne	Wiley	10/e, 2018

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Modern Operating Systems	Andrew S. Tanenbaum Herbert Bos	Pearson	5/e, 2012
2	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994
3	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx

SEMESTER S4

COMPUTER ORGANIZATION AND ARCHITECTURE

(Common to CS/CD/CR/CA/AD/CB/CN/CC/CU/CG)

Course Code	25CSZ404	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST305	Course Type	Theory

Course Objectives

1. Introduce principles of computer organization and the basic architectural concepts using RISC.
2. Introduce the concepts of microarchitecture, memory systems, and I/O systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Structure of computers :- Functional units - Basic operational concepts; Memory map; Endianness. CISC vs RISC architectures :- RISC Introduction - Assembly Language, Assembler directives, Assembling. Programming concepts - Program flow, Branching, Conditional statements, Loops, Arrays, Function calls; Instruction execution cycle. Machine language - Instructions, addressing modes, Stored program concept. Evolution of the RISC Architecture.	11
2	Microarchitecture - Introduction; Performance analysis; Single-Cycle Processor - Single Cycle Datapath, Single Cycle Control; Pipelined Processor - Pipelined Data Path, Pipelined Control: Hazards, Solving Data/Control Hazards, Performance Analysis.	11
3	Memory Systems : Introduction; performance analysis; Caches - basic concepts, Cache mapping, Cache replacement, Multiple-Level Caches, Reducing Miss Rate, Write Policy; Virtual Memory - Address Translation; Page Table; Translation Lookaside Buffer; Memory Protection.	11

4	Input / Output - External Devices; I/O Modules; Programmed I/O, Interrupt Driven I/O; Direct Memory Access; Embedded I/O Systems - Embedded I/O, General Purpose I/O, Serial I/O, Other Peripherals.	11

Suggestion on Project Topics

Use simulators such as Ripes (<https://github.com/mortbopet/Ripes>) / GEM5 (<https://www.gem5.org/>) implement components of computer systems such as Various Cache organization and study the effect, Solutions to hazards, TLBs.

Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 subdivisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the basic structure and functional units of a digital computer and the features of RISC architecture.	K2
CO2	Experiment with the single cycle processor, pipelining, and the associated problems.	K3
CO3	Utilize the memory organization in modern computer systems.	K3
CO4	Experiment with the I/O organization of a digital computer.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Digital Design and Computer Architecture - RISC-V Edition	Sarah L. Harris, David Harris	Morgan Kaufmann	1/e, 2022
2	Computer Organization and Architecture Designing for Performance	William Stallings	Pearson	9/e, 2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Organization and Design : The Hardware/Software Interface: RISC-V Edition	David A. Patterson John L. Hennessy	Morgan Kaufman	1/e,2018
2	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	McGraw Hil	6/e, 2012
3	Modern Computer Architecture and Organization	Jim Ledin	Packt Publishing	1/e,2020

Video Links (NPTEL, SWAYAM...)	
Sl. No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105163/
2	https://archive.nptel.ac.in/courses/106/106/106106166/

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S4

INTRODUCTION TO PARALLEL & DISTRIBUTED PROGRAMMING

Course Code	25CCT411	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course objectives:

1. Identify the models and frameworks best suited to various workloads.
2. Constructing parallel and distributed applications, including testing, debugging and performance evaluation

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Distributed System: Definition, Relation to computer system components, Motivation, Primitives for distributed communication, Design issues, Challenges and applications. Leader election algorithm- Bully algorithm, Ring algorithm. Termination detection- Spanning tree-based algorithm.	9
2	Distributed mutual exclusion algorithms- System model, Requirements of mutual exclusion algorithm. Lamport's algorithm, Ricart- Agrawala algorithm, Quorum based mutual exclusion algorithms- Maekawa's algorithm. Token based algorithm- Suzuki-Kasami's broadcast algorithm.	9
3	Parallel Computing: Principles of Parallel Algorithm Design Decomposition Techniques, Characteristics of Tasks and interactions, Mapping techniques for load balancing. Basic Communication operations: One to All Broadcast and All to One Reduction, All to All Broadcast and Reduction, All Reduce	11

	And Prefix Sum operations, Scatter and Gather, All to All Personalized communication, Circular Shift, Improving the speed of some communication operation.	
4	Principles of Message Passing Programming, The building blocks: Send and Receive Operations, MPI: The Message Passing Interface, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate election algorithm and termination detection algorithm.	K2
CO2	Compare token based, non-token based and quorum based mutual exclusion algorithms	K2
CO3	Appreciate the communication models for parallel algorithm development	K2
CO4	Develop parallel algorithms using message passing paradigms.	K3
CO5	Demonstrate the fundamentals skills of heterogenous computing with shared memory architecture.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	3	2									2
CO3	3	2										2
CO4	3	2	2	2	2							2
CO5	3	2			2	2						2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Parallel Computing	AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar		Second edition,2003
2	Distributed Computing Principles, Algorithms, and Systems	Ajay D. Kshemkalyani University of Illinois at Chicago, Chicago and Mukesh Singhal University of Kentucky, Lexington	Cambridge University Press	First Edition,2008
3	Distributed system	Maarten van Steen Andrew S Tanebaum	Pearson Education,Inc.	Third edition ,2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Art of Multiprocessor Programming	Maurice Herlihy and NirShavit	Morgan Kaufmann Publishers	2008
2	Principles of Parallel Programming	C. Lin, L. Snyder, Addison-Wesley		2009
3	Distributed Systems: Concepts and Design	George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair	Addison Wesley	Fifth edition
4	An Introduction to Distributed Algorithms	Valmir C. Barbosa	MIT Press	2003

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=R1FfoED7OGo&t=13s&pp=ygUqYnVsbHkgYWxnb3JpdGhtIGluIGRpc3RyaWJ1dGVkIH5c3RlbSBjb2Rl
2	https://www.youtube.com/watch?v=yduKTBqVAH8&pp=ygUvdG9rZW4gYmFzZWQgYWxnb3JpdGhtcyBpbjBkaXN0cmliZXRIZCBjb21wdXRpbmc%3D
3	https://www.youtube.com/watch?v=huwsVa6wXRM&pp=ygUeYmFzaWMgY29tbXVuaWNhdGlubiBvcGVyYXRpb25z
4	https://www.youtube.com/watch?v=QkV_5lNF1Lw&pp=ygUZTVBJElOlFBBUkFMTEVMIENPTVBVVElORw%3D%3D

SEMESTER S4

INTRODUCTION TO BLOCK-CHAIN TECHNOLOGIES

Course Code	25CCT412	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
2. To create cryptocurrencies and give a strong technical understanding of Blockchain technologies with an in-depth understanding of applications, open research challenges, and future directions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Cryptography: Concepts and Techniques-Introduction, plaintext and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography. Introduction to block-chain – basic ideas behind blockchain, generic elements of a blockchain. Types -private, public, hybrid blockchain. Applications of Blockchain in E-Governance, Land Registration, Medical Information Systems, and others. Benefits & Limitations of blockchain.	9
2	Blockchain: Versions, variants, usecases, life-usecases of blockchain, Blockchain vs shared database. The real need for mining – Consensus – definition, types, consensus in blockchain, Byzantine Generals Problem, and Consensus as a distributed coordination problem. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization.	9

3	Introduction to crypto-currency: definition, types, applications. Introduction to Bitcoins: Definition, Bitcoin Digital Keys & Addresses, Transactions, Limitations of Bitcoins. Introduction to Blockchain platforms: Ethereum, Hyperledger, IOTA, EOS, Multichain, Bigchain etc. Advantages & disadvantages.	9
4	Smart Contracts – Definition, Smart contract templates, Oracles, Types of oracles, Deploying smart contracts. Ethereum – The Ethereum network. Components of the Ethereum ecosystem – Keys and addresses, Accounts, Transactions and messages.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the cryptographic building blocks and fundamental concepts of blockchain technology.	K2
CO2	Explain the concepts of consensus and decentralization in blockchain.	K2
CO3	Explain the concepts of first decentralized cryptocurrency bitcoin and blockchain platforms.	K2
CO4	Explain the use of smart contracts and Ethereum.	K2
CO5	Illustrate the development of blockchain applications.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming	Josh Thompson	Create Space Independent Publishing Platform	2017
2	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more,	Imran Bashir	Packt Publishing	second edition, 2018.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain	Ritesh Modi	Packt Publishing	First edition, 2018
2	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	Wiley Publications	First edition, 2020
3	Blockchain Technology	Chandramouli Subramanian, Asha A George,	Universities Press (India) Pvt. Ltd.	First edition, August 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=WeuJqKEfSxM&pp=ygUaaW50cm9kdWN0aW9uIHRvIGJsb2NrY2hhaW4%3D
2	https://www.youtube.com/watch?v=rYQgy8QDEBI&pp=ygUOY3J5cHRvY3VycmVuY3k%3D
3	https://www.youtube.com/watch?v=jxLkbJozKbY&t=34s&pp=ygUQYml0Y29pbjBwbGF0Zm9ybQ%3D%3D
4	https://www.youtube.com/watch?v=1B81CiQj21E&pp=ygU4Y29uc2Vuc3VzI0KAkyBkZWZpbml0aW9uLCB0eXBlcwY29uc2Vuc3VzIGluIGJsb2NrY2hhaW4%3D

SEMESTER S4**INTRODUCTION TO AI AND ML**

Course Code	25CCT413	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the fundamental principles of AI and ML, including intelligent agents, problem-solving techniques, knowledge representation, various learning paradigms, and evaluation metrics.
2. Develop practical skills in implementing Machine Learning algorithms like supervised and unsupervised learning algorithms, model selection techniques, and basic deep learning architectures.
3. Analyze the applications and ethical implications of AI and ML across different domains including fairness, explainability, and societal impact.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to AI - History and Applications of AI: Intelligent Agents - Types of intelligent agents, Problem-solving & search algorithms (uninformed and informed search): Knowledge Representation and Reasoning - Propositional logic, First-order logic, Reasoning systems Introduction to Machine Learning: Machine learning vs. traditional programming, Types of learning (supervised, unsupervised, reinforcement learning). The Machine Learning Pipeline, Data Preprocessing, Idea of Training, Testing, Validation; Review of Gradient Descent Algorithm	9
2	Supervised Learning: Linear Regression, Decision Trees, K-Nearest Neighbors(KNN) Unsupervised Learning: Principal Component Analysis (PCA), K-means clustering	9

	Model Selection and Regularization: Underfitting, Overfitting, L1 and L2 regularization. Evaluation measures – Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination, Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC), Cross-entropy loss.	
3	Introduction to Neural Networks and Deep Learning: Perceptron, Multilayer Feed-Forward Network; Activation Functions - Sigmoid, ReLU, Tanh Backpropagation Algorithm; Artificial Neural Networks (ANNs), Activation Functions, Convolutional Neural Networks (CNNs), Architecture, Applications. Case Study: Application of ML for Phishing Detection	9
4	Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks: Architecture, Applications (General understanding of natural language processing) Ethical Considerations in AI and ML: Bias, Fairness, Explainability, Societal Impact Case Study: Application of AI for Intrusion Detection	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Students will Understand and will be able to explain the fundamental principles of AI	K2
CO2	Students will be able to select, apply, implement, regularize and evaluate supervised and unsupervised learning algorithms.	K3
CO3	Students will be able to design, train, and optimize neural networks and will Understand Deep Learning concepts like ANN and CNN	K2
CO4	Students will Understand applications of DL in NLP and will be able to Analyse AI based on ethical considerations.	K2
CO5	Students will be able to analyze and apply AI and ML techniques in cybersecurity through specific case studies, understanding their practical implementations, challenges, and effectiveness in real-world scenarios.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									2
CO2	3	3	2	2	3					2		2
CO3	3	3	3	2	3					2		2
CO4	3	2	2		3	3		3	2	3		3
CO5	3	3	3	3	3	2		3	2	3		3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Pearson	4th Edition (2022)
2	Machine Learning for Dummies	John Paul Mueller and Luca Massaron	Wiley	2nd Edition (2021)

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc	2nd Edition (2019)
2	Artificial Intelligence for Humans	Jeff Heaton	Heaton Research LLC	3rd Edition (2020)
3	Artificial Intelligence Basics: A Non-Technical Introduction	Tom Taulli	Manning Publications	2019
4	Machine Learning	Tom Mitchell	McGraw-Hill	1997
5	The Hundred-Page Machine Learning Book	Andriy Burkov		2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJkbn_laSHcH
2	https://www.youtube.com/watch?v=T3PsRW6wZSY&list=PLIg1dOXc_acbdJo-AE5RXpIM_rvwrerwR
3	https://www.youtube.com/watch?v=QlhHqMnd9Wo
4	https://www.youtube.com/watch?v=KjDWcYHclOM

SEMESTER S4

FUNDAMENTALS OF INDUSTRIAL CONTROL SYSTEM SECURITY

Course Code	25CCT414	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Enables the learners to understand the basic concepts of Industrial control system.
2. The course helps the students to identify the difference between OT and IT networks in Industrial Systems.
3. Enables the students to describe the different cyber security controls and Access control Mechanisms.
4. Enables the learners to summarize the operation, design and vulnerabilities of Industrial Control System and understand various Networking and Industrial protocols.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ICS(Industrial Control System) System Overview: Industrial Control System Architecture-Distributed Control Systems (DCS)-Programmable Logic Controller (PLC) - SCADA overview. Building Automation and Control System Overview, Safety Instrumented Systems, Industrial Internet of Things	9
2	Purdue Model for Industrial Control Systems, Difference Between OT and IT Networks in Industrial Systems , OT Versus IT ICS Fundamentals: Operation, Design, and Vulnerabilities, Networking and Industrial Protocols. Case Study: Stuxnet	10
3	Cyber security Controls in Industry Introduction to Cyber security Controls: Definition and Importance, Types of Cyber security Controls (Preventive,	10

	Detective, Corrective) Industry Standards and Frameworks (NIST, ISO/IEC 27001, CIS Controls) Access Control Mechanisms User Authentication (Passwords, Multi-Factor Authentication), User Authorization (Role-Based Access Control, Attribute-Based Access Control) Access Control Models (Discretionary, Mandatory, and Role-Based Access Control)	
4	Cyber Attacks and Problems, Anatomy of a Cyber Attack, Defense in Depth Principle, Contemporary Control System Architectures, Asset management in Cyber Security, Network segmentation, Network Discovery Auditing and Assessing ICS: Methodology and Characterization, System Assessment and Classification, Vulnerability Identification, Standards and Best Practices for Industrial Security. Applications and benefits of Industry Control systems	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the basic concepts of Industrial Control systems and differentiate between different types of Industrial Control Systems.	K2
CO2	Identify the difference between OT and IT networks in Industrial Systems and also describe Contemporary Control System Architecture.	K2
CO3	Describe on the types of Cyber Security Controls and Access Control Mechanisms.	K2
CO4	Summarize the operation, design and vulnerabilities of Industrial Control System and understand various Networking and Industrial protocols.	K2
CO5	Outline the System Assessment, Vulnerability Identification and best practices for Industrial Safety and understand the applications of Industrial Control Systems.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									3
CO2	3	3	2									3
CO3	3	2	2									3
CO4	3	2	2	2	2	2	2					3
CO5	3	3	2	2		2	2	2				3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Programmable Logic Controllers	Gary Dunning	Delmar Cengage Learning	Thomson 2nd edition, 2013
2	SCADA Supervisory Control and Data Acquisition	Stuart A Boyer	ISA	4 th Edition, 2009
3	Computer Security : Principles and Practice	William Stallings Lawrie Brown	Pearson	3 rd Edition, 2014
4	Industrial Network Security :Securing Critical Infrastructure Networks for Smart Grid, SCADA and other Industrial Control Systems	Eric D Knapp Joel Thomas Langill	Syngress	2 nd Edition, 2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Automation using PLC , SCADA & DCS	R.G.Jamkar	Global Education Ltd	2 nd Edition, 2018
2	Industrial Automation and Process Control	Jon Stenerson	Prentice Hall	1 st Edition, 2002
3	Effective Cyber security : A Guide to Using Best Practices and Standards	William Stallings	Addison-Wesley Professional	1 st edition, 2018
4	Control Systems Cyber Security: Defense in Depth Strategies	David Kuipers Mark Fabro	Idaho National Laboratory Idaho Falls, Idaho 83415	May 2006

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/108105063
	https://www.udemy.com/course/cyber-security-industrial-control-system-security
2	https://www.udemy.com/course/cyber-security-industrial-control-system-security
3	https://www.udemy.com/course/mastering-cybersecurity-and-supply-chain-risk-management
4	https://www.udemy.com/course/assessingprotectingics

SEMESTER S4

ADVANCED DATA STRUCTURES

(Common to CS/CD/CM/CA/AM/CB/CN/CC/CU/CI/CG)

Course Code	25CST495	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CST303	Course Type	Theory

Course Objectives:

1. To equip students with comprehensive knowledge of advanced data structures utilized in cutting-edge areas of computer science, including database management, cyber security, information retrieval, and networked systems.
2. To prepare students to address challenges in emerging fields of computer science by applying advanced data structures to practical, real-world problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Foundational Data Structures- Overview of Arrays and Linked Lists, implementation of pointers and objects, Representing rooted trees, Hashing - Hash Tables, Hash functions, Cuckoo Hashing; Bloom Filters - Count-Min Sketch, Applications to Networks - Click Stream Processing using Bloom Filters, Applications to Data Science - Heavy Hitters and count-min structures.	11
2	Advanced Tree Data Structures - Balanced Trees - AVL Trees (review), Red-Black Trees, Suffix Trees and Arrays, Segment Trees, Heaps and Related Structures – Binomial heap, Fibonacci Heaps, Merkle Trees, Applications to information Retrieval and WWW - AutoComplete using Tries.	11
3	Specialized Data Structures - Spatial Data Structures – Quadtree, K-D Trees (k-dimensional tree); R-trees; Temporal Data Structures- Persistence, Retroactivity; Search and Optimization Trees – Skip List, Tango Trees; Applications to Data Science - Approximate nearest neighbor search,	12

	Applications to information Retrieval and WWW, Posting List intersection.	
4	Data Structure applications - Distributed and Parallel Data Structures - Distributed Hash Tables (DHTs); Consistent Hashing; Distributed BST; Data Compression and Transformations - Burrows-Wheeler Transform; Histogram; Wavelet Trees; Cryptographic Applications – Hashing.	11

Course Assessment Method
(CIE: 40 marks,ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation (Evaluate and Analyze): 20 marks

Implement various real world problems using multiple suitable data structures and compare the performance.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. • Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Implement and use arrays, linked lists, rooted trees and hashing techniques in various programming scenarios.	K3
CO2	Design and implement advanced tree data structures for information retrieval.	K3
CO3	Use spatial and temporal data structures in data science problems.	K3
CO4	Analyze data structures in special scenarios such as distributed, parallel and data compression areas.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3						2	3
CO2	3	3	3	3	3						2	3
CO3	3	3	3	3	3						2	3
CO4	3	3	3	3	3						2	2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Advanced Data Structures: Theory and Applications	Suman Saha, Shailendra Shukla	CRC Press	1/e, 2019
2	Advanced Data Structures	Peter Brass	Cambridge University Press	1/e, 2008
3	Introduction to Algorithms	Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	4/e, 2022
4	Fundamentals of Computer Algorithms	Ellis Horowitz, Satraj Sahani and Rajasekharam	University Press	2/e, 2009
5	Advanced Data Structures	Reema Thareja, S. Rama Sree	Oxford University Press	1/e, 2018
6	Data Structures and Algorithm Analysis in C++,	Mark Allen Weiss	Pearson	2/e, 2004.
7	Design and Analysis of Algorithms	M T Goodrich, Roberto Tamassia	Wiley	1/e, 2021

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://web.stanford.edu/class/cs166/

SEMESTER S3/S4**ECONOMICS FOR ENGINEERS**

Course Code	25HUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with an understanding of fundamental economic principles essential for effective decision-making in engineering contexts.
2. To enable students to apply economic analysis to production decisions, cost management, and market strategies in engineering practice.
3. To equip students with the ability to evaluate macroeconomic scenarios, financial methods, and investment decisions relevant to engineering projects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility –Demand: Factors determining demand – Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Law of supply – Supply curve- Equilibrium price determination- Changes in demand and supply and its effects on equilibrium price and quantity Production: Production function - Law of variable proportion –Returns to scale- Cobb-Douglas Production Function	6
2	Cost: Cost concepts – Private cost and social cost – Sunk cost – Opportunity cost -Explicit and implicit cost –Short run cost curves –Long run average cost curve -Revenue concepts – Break-even point Market: Perfect Competition – Monopoly - Monopolistic Competition (features and equilibrium of a firm) - Oligopoly – Features – Kinked demand model	6

3	National income: Concepts (GDP, GNP and NNP)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method-- Difficulties in the measurement of national income. Inflation: Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Repo and reverse repo rate	6
4	Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure Capital Budgeting: Time value of money - Net Present Value Method - Benefit Cost Ratio – Internal Rate of Return – Payback – Accounting Rate of Return.	6

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/Case Study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
- Minimum 1 and Maximum 2 Questions from each module. - Total of 6 Questions, each carrying 3 marks (6x3 =18 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems and national income.	K2
CO4	Make use of the possibilities of value analysis and engineering, and take investment decisions through capital budgeting techniques.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012
4	Financial Management	I M Pandey	Vikas Publishing House	2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001
5	Financial Management: Theory and Practice	Prasanna Chandra	Mc Graw Hill	2007

SEMESTER S3/S4

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	25HUT347	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
2. Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
3. Develop the ability to find strategies for implementing sustainable engineering solutions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology,	6

	Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	
2	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	6
3	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E-Mobility, Existing and upcoming models of sustainable mobility solutions.	6
4	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental	6

	policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	

**Course Assessment Method
(CIE: 50 marks , ESE: 50)**

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and reflections)	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5
		3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarising the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
Total Marks				50

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	3	3	2		2
CO2		1				3	2	3	3	2		2
CO3						3	3	2	3	2		2
CO4		1				3	3	2	3	2		2
CO5						3	3	2	3	2		2

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessment	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

Suggested Activities/Projects:

Module-II

- Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
- Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
- Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
- Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
- Develop a conservation plan for an endangered species found in Kerala.
- Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
- Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

- Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
- Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
- Implement a zero waste initiative on the college campus for one week and document the challenges and outcomes.
- Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
- Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
- Design a product or service based on circular economy and degrowth principles and present a business plan.
- Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

- Evaluate the potential for installing solar panels on the college campus including cost-benefit analysis and feasibility study.
- Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy-saving gadgets?
- Analyse a local infrastructure project for its climate resilience and suggest improvements.
- Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
- Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
- Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

SEMESTER S4

OPERATING SYSTEMS LAB

(Common to CS/CD/CM/CR/CA/AI/CB/CN/CC/CU/CI/CG)

Course Code	25CSL407	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST204	Course Type	Lab

Course Objectives:

1. To familiarize various Linux commands related to Operating systems.
2. To give practical experience for learners on implementing different functions of Operating systems such as process management, memory management, and disk management.

Expt. No.	Experiments
1	Familiarisation with basic Linux programming commands: ps, strace, gdb, strings, objdump, nm, file, od, xxd, time, fuser, top
2	Use /proc file system to gather basic information about your machine: (a) Number of CPU cores (b) Total memory and the fraction of free memory (c) Number of processes currently running. (d) Number of processes in the running and blocked states. (e) Number of processes forked since the last bootup. How do you compare this value with the one in (c) above? (f) The number of context switches performed since the last bootup for a particular process.
3	Write a simple program to print the system time and execute it. Then use the /proc file system to determine how long this program (in the strict sense, the corresponding process) ran in user and kernel modes.
4	Create a new process using a fork system call. Print the parent and child process IDs. Use the pstree command to find the process tree for the child process starting from the init process.
5	Write a program to add two integers (received via the command line) and compile it to an executable named “ myadder ”. Now write another program that creates a new process using a fork system call. Make the child process add two integers by replacing its image

	with the “myadder” image using execvp system call.
6	Create a new process using a fork system call. The child process should print the string “PCCSL407” and the parent process should print the string “ Operating Systems Lab ”. Use a wait system call to ensure that the output displayed is “ PCCSL407 Operating Systems Lab ”
7	Inter-process Communication (https://www.linuxdoc.org/LDP/lpg/node7.html) (a) Using Pipe – Evaluate the expression $\sqrt{b^2 - 4ac}$. The first process evaluates b^2. The second process evaluates $4ac$ and sends it to the first process which evaluates the final expression and displays it. (b) Using Message Queue - The first process sends a string to the second process. The second process reverses the received string and sends it back to the first process. The first process compares the original string and the reversed string received from the second one and then prints whether the string is a palindrome or not. (c) Using Shared Memory - The first process sends three strings to the second process. The second process concatenates them to a single string (with whitespace being inserted between the two individual strings) and sends it back to the first process. The first process prints the concatenated string in the flipped case, that is if the concatenated string is “Hello S4 Students”, the final output should be “HELLO s4 sTUDENTS”
8	Write a multithreaded program that calculates the mean, median, and standard deviation for a list of integers. This program should receive a series of integers on the command line and will then create three separate worker threads. The first thread will determine the mean value, the second will determine the median and the third will calculate the standard deviation of the integers. The variables representing the mean, median, and standard deviation values will be stored globally. The worker threads will set these values, and the parent thread will output the values once the workers have exited.
9	Input a list of processes, their CPU burst times (integral values), arrival times, and priorities. Then simulate FCFS, SRTF, non-preemptive priority (a larger priority number implies a higher priority), and RR (quantum = 3 units) scheduling algorithms on the process mix, determining which algorithm results in the minimum average waiting time (over all processes).
10	Use semaphores to solve the readers-writers problem with writers being given priority over readers.
11	Obtain a (deadlock-free) process mix and simulate the banker’s algorithm to determine a safe execution sequence.
12	Obtain a process mix and determine if the system is deadlocked.
13	Implement the deadlock-free semaphore-based solution for the dining philosopher’s problem.
14	Simulate the address translation in the paging scheme as follows: The program receives

	three command line arguments in the order • size of the virtual address space (in megabytes) • page size (in kilobytes) • a virtual address (in decimal notation) The output should be the physical address corresponding to the virtual address in <frame number, offset> format. You may assume that the page table is implemented as an array indexed by page numbers. (NB: If the page table has no index for the page number determined from the virtual address, you may just declare a page table miss!)
15	Simulate the FIFO, LRU, and optimal page-replacement algorithms as follows: First, generate a random page-reference string where page numbers range from 0 to 9. Apply the random page-reference string to each algorithm, and record the number of page faults incurred by each algorithm. Assume that demand paging is used. The length of the reference string and the number of page frames (varying from 1 to 7) are to be received as command line arguments.
16	Simulate the SSTF, LOOK, and CSCAN disk-scheduling algorithms as follows: Your program will service a disk with 5,000 cylinders numbered 0 to 4,999. The program will generate a random series of 10 cylinder requests and service them according to each of the algorithms listed earlier. The program will be passed the initial position of the disk head (as a parameter on the command line) and will report the total number of head movements required by each algorithm.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total

10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the use of various systems calls in Operating Systems.	K3
CO2	Implement process creation and inter-process communication in Operating Systems	K3
CO3	Compare the performance of various CPU scheduling algorithms	K4
CO4	Compare the performance of various disk scheduling algorithms	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3				3				3
CO2	3	3	3	3				3				3
CO3	3	3	3	3				3				3
CO4	3	3	3	3				3				3
CO5	3	3	3	3				3				3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Operating Systems: Three Easy Pieces	Andrea Arpaci-Dusseau, Remzi Arpaci-Dusseau	CreateSpace	1/e, 2018
2	Linux Kernel Development	Robert Love	Pearson	3/e, 2018
3	Unix Network Programming - Volume 2: Interprocess Communications	Richard Stevens	Prentice Hall	2/e, 1999

Reference Books/Websites				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Design of the UNIX Operating System	Maurice J. Bach	Prentice Hall of India	1/e, 1994
2	The Little Book of Semaphores	Allen B. Downey	Green Tea Press	1/e, 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105214/
2	https://www.youtube.com/playlist?list=PLDW872573QAb4bj0URobvQTD41IV6gRkx

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S4

DBMS Lab

(Common to CS/CD/CR/CA/AD/AI/CB/CN/CC/CU/CI/CG)

Course Code	25CSL408	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. To equip students with comprehensive skills in SQL, PL/SQL, and NoSQL databases.
2. To enable the learner to proficiently design, implement, and manage relational and non-relational databases to meet diverse data management needs

Expt. No.	Experiments
1	Design a database schema for an application with ER diagram from a problem description.
2	Creation of database schema - DDL (create tables, set constraints, enforce relationships, create indices, delete and modify tables). Export ER diagram from the database and verify relationships (with the ER diagram designed in step 1).
3	Database initialization - Data insert, Data import to a database (bulk import using UI and SQL Commands).
4	Practice SQL commands for DML (insertion, updating, altering, deletion of data, and viewing/querying records based on condition in databases).
5	Implementation of various aggregate functions, Order By, Group By & Having clause in SQL.
6	Implementation of set operators nested queries, and join queries.
7	Practice of SQL TCL DCL commands like Rollback, Commit, Savepoint, Practice of SQL DCL commands for granting and revoking user privileges.
8	Practice of SQL commands for creation of views and assertions.
9	Creation of Procedures, Triggers and Functions.
10	Creation of Packages and cursors.
11	Design a database application using any front-end tool for any problem selected in

	experiment number 1. The application constructed should have five or more tables**.
12	Perform basic CRUD (Create, Read, Update, Delete) operations on a Cassandra table.
13	Write and execute CQL queries to retrieve specific data from Cassandra tables
14	Create a simple application using MongoDB with python

** The problem must be designed to convey the difference of NoSQL from SQL databases.

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop database schema for a given real world problem-domain using standard design and modeling approaches	K3
CO2	Construct queries using SQL for database creation, interaction, modification, and updation.	K3
CO3	Plan and implement triggers and cursors, procedures, functions, and control structures using PL/SQL	K3
CO4	Perform CRUD operations in NoSQL Databases	K3
CO5	Design database applications using front-end tools and back-end DBMS	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1						3		3
CO2	3	3	3	1						3		3
CO3	3	3	3	1						3		3
CO4	3	3	3	2	3					3		3
CO5	3	3	3	2	3					3	3	3

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Database Systems	Elmasri, Navathe	Pearson	7/e, 2017
2	Professional NoSQL	Shashank Tiwari	Wiley	1/e, 2011

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Database System Concepts,	Sliberschatz Korth and S. Sudarshan	McGraw Hill,	7/e, 2017
2	NoSQL for Dummies	Adam Fowler	John Wiley & Sons	1/e, 2015
3	NoSQL Data Models: Trends and Challenges (Computer Engineering: Databases and Big Data),	Olivier Pivert	Wiley	1/e, 2018
4	Making the Sense of NoSQL : A guide for Managers and Rest of us.	Dan McCreary and Ann Kelly	Manning	1/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
3	https://onlinecourses.nptel.ac.in/noc21_cs04/preview
4	https://archive.nptel.ac.in/courses/106/104/106104135/

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
 - Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.

Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment

- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
 - Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 5

**COMPUTER SCIENCE AND ENGINEERING
CYBER SECURITY**

SEMESTER S5

APPLIED CRYPTOGRAPHY

Course Code	25CCT501	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CCT501	Course Type	Theory

Course Objectives:

1. Understand the fundamental principles of cryptography and network security.
2. Learn and apply cryptographic techniques and protocols.
3. Analyse the security mechanisms of symmetric and asymmetric cryptography.
4. Explore advanced cryptographic applications and emerging trends.
5. Implement security solutions in cloud computing, quantum computing, and IoT.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Cryptography and Security Introduction to Cryptography: Definition and History of Cryptography - Importance and Applications - Key Terminologies and Concepts - Types of Attacks Classical Encryption Techniques: Substitution Ciphers: Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polybius Square Transposition Ciphers: Rail Fence, Columnar Transposition Steganography: Principles of Steganography, Types of Steganography, Steganography Versus Digital Watermarking, Types of Digital Watermarking, Goals of Digital Watermarking. Quick Review of Number Theory: Prime Numbers, Modular Arithmetic, Greatest Common Divisor, Fermat's and Euler's Theorems, Chinese Remainder Theorem	10

2	Cryptographic Concepts and Techniques Symmetric Key Cryptography: Block Ciphers: DES, 3DES, AES (Block Level only) - Stream Ciphers: RC4 - Modes of Operation: ECB, CBC, CFB, OFB, CTR Asymmetric Key Cryptography: Principles of Public Key Cryptosystems- RSA Algorithm-Diffie-Hellman Key Exchange-Elliptic Curve Cryptography	10
3	Cryptographic Hash Functions: Hash Function Requirements and Properties, SHA-256, SHA-3, MD5, HMAC Message Authentication and Cryptographic Protocols Message Authentication Codes: Structure and Usage, CMAC, GMAC, Digital Signatures: RSA, DSA, ECDSA Cryptographic Protocols: Key Management and Distribution, Public Key Infrastructure (PKI), SSL/TLS Protocol	11
4	Secure Electronic Transactions: E-commerce Security Requirements, Payment Protocols - SET, 3D Secure, Cryptographic Tokens Advanced Cryptographic Applications and Emerging Trends Advanced Cryptographic Techniques: Homomorphic Encryption, Zero-Knowledge Proofs Quantum Cryptography: Basics and Algorithms; Cryptography in Cloud Computing and IoT: Security Challenges and Cryptographic Solutions in Cloud Computing, Challenges and Cryptographic Solutions in IoT	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Students will be able to understand the fundamental principles and historical context of cryptography, including key terminologies and classical encryption techniques.	K3
CO2	Students will be able to implement and analyze symmetric and asymmetric cryptographic algorithms, hash functions, and message authentication codes.	K3
CO3	Students will demonstrate the ability to apply cryptographic protocols to secure communication, key management, and electronic transactions.	K2
CO4	Students will be able to understand advanced cryptographic applications and emerging trends, including security in cloud computing, IoT, and quantum computing.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2						1				
CO2	3	3			3			1				
CO3	3	3	3		3			1	1			
CO4	3		2	3	3			1				2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography and Network Security: Principles and Practices	William Stallings	Pearson	8th Ed, 2021
2	Introduction to Modern Cryptography: Principles and Protocols	Jonathan Katz and Yehuda Lindell	CRC Press	2020 (3rd Edition)

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Cryptography: Protocols, Algorithms, and Source Code in C	Bruce Schneier	Wiley	2015
2	Cryptography and Network Security: Black Book	William Easttom	Dreamtech Press	2017
3	Understanding Cryptography: A Textbook for Students and Practitioners	Christof Paar and Jan Pelzl	Springer	2009
4	Network Security Essentials: Applications and Standards	William Stallings	Pearson	2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=iTVyKbDCJrA
2	https://www.youtube.com/watch?v=UxtR-CB69Rw
3	https://www.youtube.com/watch?v=FOk8TN7HQLo
4	https://www.youtube.com/watch?v=9XC4mY_3X2I

SEMESTER S5

NETWORK AND SYSTEM SECURITY

Course Code	25CCT502	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)		Course Type	Theory

Course Objectives:

1. Enables the learners to understand network security domain, the techniques for network protection
2. This course helps to identify the attacks and defence in Data and wireless networks.
3. Enables the students to the basic functionalities and hardening of Windows and Linux operating system.
4. This course helps to identify the attacks and security in internet and web service.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Module-1 (Principles of Network Security) Principles of network security, Network Security Terminologies, CIA TRIAD Components of Network Security- Network Firewall-types, rules, personal firewalls, Intrusion Detection and Prevention System, Advanced Threat Protection, Network access Control, Web filtering. Network Security Policies. Network segments, Perimeter Defense, NAT, Penetration testing.	10
2	Module-2(Network Security) Network Attacks, Services and Mechanisms, Network Security model, Network security and their relation to Steganography , Security in Data Networks, Wireless Device security issues- GPRS security, GSM security, IP security. Wireless Transport Layer Security-Secure Socket Layer, Wireless	10

	Transport Layer Security - WAP Security, WAP security Architecture, WAP Gateway.	
3	Module-3(System Security) Windows Security: Attacks against windows system, Installing applications, Authentication and access control, Upgrades and Patches, Operating Windows safely,. Linux Security- Attacks in Linux system, Physical security, Controlling the configuration, Authentication and access control, Upgrades and Patches, Operating Linux safely.	9
4	Module-4 (Web Security) Web Browser and Client risk- How a web browser works, Web browser attacks, Operating safely, Web security- How HTTP works, Server and Client contents, Attacking Web servers, Web Services. E-mail security- The e-mail risk, Protocols, Authentication, Operating safely when using email, Domain Name System – DNS basics, Purpose of DNS, Security Issues with DNS, DNS attacks. - WAP Gateway.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain network security domain, the techniques for network protection and explore new tools and attacks in Network security domain.	K1
CO2	Identify the attacks and defence in wireless and data networks.	K2
CO3	Explain the functionalities and hardening of windows and Linux operating systems.	K1
CO4	Explain the various attacks as well as security measures in Internet and Web services.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2		2			3		3		3
CO2	2	3	2		2			3		2		2
CO3	2	2	2		2			3		3		2
CO4	2	2	2		2			3		2		2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Network Security Bible	Eric Cole, Ronald Krutz, James W. Conley,	Wiley India Pvt Ltd, 2010	First Edition, 2010
2	Principles of Information Security	Michael A Whitman, Herbert J. Mattord	Cengage Learning	4 th Edition, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Network Security Essentials	William Stallings	Pearson Education	4 th Edition, 2011
2	Fundamentals of Network security	Michael A Whitman, Herbert J. Mattord	Tata McGraw-Hill	1 st Edition, 2011

Video Links (NPTEL, SWAYAM...)	
Link ID	
https://nptel.ac.in/courses/106106129 https://onlinecourses.swayam2.ac.in/nou24_cs13/preview	
https://onlinecourses.nptel.ac.in/noc24_cs80/preview https://nptel.ac.in/courses/106106129	
https://nptel.ac.in/courses/106106129 https://www.udemy.com/course/web-security-and-bug-bounty-learn-penetration-testing/	
https://nptel.ac.in/courses/106106129	

SEMESTER S5

MACHINE LEARNING
(Common to CS/AD/CR/CA/CC/CD)

Course Code	25CST503	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To impart the fundamentals principles of machine learning in computer and science.
2. To provide an understanding of the concepts and algorithms of supervised and unsupervised learning.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ML :- Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Parameter Estimation - Maximum likelihood estimation (MLE) and maximum a posteriori estimation (MAP), Bayesian formulation. Supervised Learning :- Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables : solution using gradient descent algorithm and matrix method.	9

2	Classification - Logistic regression, Naïve Bayes, KNN, Decision Trees – ID3 Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation Evaluation measures – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC). Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.	9
3	SVM – Linear SVM, Idea of Hyperplane, Maximum Margin Hyperplane, Non-linear SVM, Kernels for learning non-linear functions Neural Networks (NN) - Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm.	9
4	Unsupervised Learning Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering Dimensionality reduction - Principal Component Analysis, Multidimensional scaling Ensemble methods - bagging, boosting; Resampling methods - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance tradeoff.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods.	K2
CO2	Demonstrate supervised learning concepts (regression, classification).	K3
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	K3
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	K3
CO5	Use appropriate performance measures to evaluate machine learning models	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3
CO5	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	4/e, 2020
2	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki Wagner Meira	Cambridge University Press	1/e, 2016
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1/e, 1998

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Machine Learning	M Gopal	McGraw Hill	2/e, 2018
2	Machine Learning using Python	Manaranjan Pradhan U Dinesh Kumar	Wiley	1/e, 2019
3	Machine Learning: Theory and Practice	M.N. Murty, V.S. Ananthanarayana	Universities Press	1/e, 2024

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105152/
2	https://archive.nptel.ac.in/courses/106/106/106106139/
3	https://nptel.ac.in/courses/106106202\

SEMESTER S5
MICROCONTROLLERS
(Common to CS/CC)

Course Code	25CSZ504	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	4	ESE Marks	40
Credits	3:0:0:1	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To introduce the ARM architecture and ARM-based microcontroller architecture.
2. To impart knowledge on the hardware and software components to develop embedded systems using STM32 microcontrollers.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ARM Cortex-M Architecture:- Overview of Embedded Systems, Applications of Embedded Systems, Introduction to Embedded C, Microcontrollers vs. Microprocessors, Classification of processors, Overview of ARM Cortex-M Series, Introduction to the Cortex-M23 and Cortex-M33 processors and the Armv8-mArchitecture, ARM Core Features: Registers, Memory, and Bus Architecture, Comparison with previous generations of Cortex-M processors.	8
2	STM32 Microcontroller Overview and Peripheral Programming:- Introduction to STM32 Family, STM32U575 Features and Specifications, Power Management and Low-Power Features Libraries, Introduction to Integrated Development Environment and HAL, Writing, and Debugging Your First Program(LED Interfacing), Interfacing Seven-Segment Display, LCD Display, and Matrix Keypad, Relay Interfacing, Analog to Digital	10

	Conversion: Potentiometer, temperature sensor, LDR, Microphone, Digital to Analog Conversion: Simple DAC Output Generation, Generating a Sine Wave, Audio Signal Generation, Interrupt Handling, Timer and Counter Applications: Basic Timer Configuration, Timers as Counters, Timer-Based Real-Time Clock (RTC)	
3	Communication Protocols and USB:- Serial port terminal Application, Serial communication (USART, I2C, SPI, CAN), Interfacing an I2C Temperature Sensor and Displaying Data on an LCD, writing to and Reading from an SPI-based EEPROM, Configuring and Implementing CAN Communication between Multiple STM32U575 Microcontrollers, Creating a USB HID Device for Keyboard / Mouse Emulation	10
4	IoT, Wireless Communication, and RTOS:- Introduction to IoT, IoT Architecture, Protocols (MQTT, CoAP), IoT Security Principles and Common Threats Wireless Communication: Interfacing GSM (Call, SMS, Internet), Bluetooth Communication Basics, LoRa Communication Basics and Applications, Designing an IoT-Based Home Automation System, Introduction to RTOS Concepts, FreeRTOS with STM32: Task Creation, Scheduling, and Management, RTOS Timers, Delays, and RTC Integration, Inter-task Communication: Queues and Semaphores Trust Zone Technology: Introduction to ARM Trust Zone, Trust Zone Architecture and Features, Secure and Non-Secure Worlds: Configuration and Management, Implementing Trust Zone in STM32U575, Advanced Debugging and Optimization: Code and Memory Optimization Techniques, Debugging Strategies and Tools	16

Suggestion on Project Topics

- Identify real world problems requiring hardware solutions and develop them using peripheral devices. Some of the examples would be - Home automation, Small home/office security system, ARM based voice response system etc.

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 2 subdivisions. • Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the architectural features and instructions of the ARM microcontrollers.	K2
CO2	Develop applications involving interfacing of external devices and I/O with ARM microcontroller.	K3
CO3	Use various communication protocols of interaction with peer devices and peripherals.	K3
CO4	Demonstrate the use of a real time operating system in embedded system applications.	K3
CO5	Apply hardware security features of ARM in real world applications.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	3	3	3	3								3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors	Joseph Yiu	Newnes - Elsevier	3/e, 2014
2	Mastering STM32	Carmin Novello	Learnpub	2/e, 2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	ARM System Developer's Guide	Andrew N. Sloss, Dominic Symes, Chris Wright	Morgan Kaufman	1/e, 2008
2	Embedded System Design with Arm Cortex-M Microcontrollers	Cem Ünsalan, Hüseyin Deniz Gürhan Mehmet Erkin Yücel	Springer	1/e, 2022
3	Introduction to ARM® Cortex-M Microcontrollers	Jonathan W. Valvano	Self-Published	5/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105193/
2	https://www.st.com/resource/en/datasheet/

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S5

NETWORK FUNDAMENTALS FOR CLOUD

Course Code	25CCT521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge of networking concepts and familiarity with operating systems	Course Type	Theory

Course Objectives:

1. To understand core networking concepts, such as IP addressing, subnetting, and routing.
2. To implement cloud networking solutions, including designing and configuring virtual networks and security settings.
3. To troubleshoot network issues within cloud environments.
4. To integrate cloud and on-premises networks, managing hybrid systems effectively

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Networking Concepts and Cloud Computing:- Basics of Computer Networks: Overview of Network Types: LAN,WAN, Pan, OSI and TCP/IP Models.IP Addressing and Subnetting: IPv4 vs. IPv6 Addressing, SubnettingConcepts and Techniques. Introduction to Cloud Computing: Cloud Computing Models: IaaS, PaaS, SaaS. Cloud Architecture Overview. Networking in Cloud Environments: Importance of Networking inCloud, Interaction Between Traditional Networks and Cloud Infrastructures.	9
2	Networking Protocols and Cloud Connectivity :- TCP/IP Protocol Suite: Deep Dive into TCP/IP Protocols, Role ofTCP/IP in Cloud Environments.	9

	DNS and DHCP in the Cloud, DNS Configuration in Cloud, DHCP in Cloud Networks. Virtual Private Networks (VPN): VPN Implementation in Cloud, Securing VPNs for Cloud Connectivity. Load Balancing in Cloud: Load Balancer Types and Configurations, Implementing Load Balancers in Cloud. Virtual Private Cloud (VPC), VPC Configuration and Management, VPC Peering and Gateways. Hybrid Cloud Connectivity, Integrating Public and Private Clouds, Challenges and Solutions in Hybrid Cloud Connectivity.	
3	Cloud Networking Components, Architectures, and Security: Virtual Networking and SDN: Virtual Networks (VNet) Configuration, Principles of SDN and Implementation in Cloud, Network Function Virtualization (NFV) and Microservices: NFV Components and Architecture, Networking for Containers (Docker, Kubernetes). Cloud Network Design Principles: Designing for Scalability and Flexibility, Redundancy and Disaster Recovery Planning. Security in Cloud Networks: Cloud-Native Security Controls, Intrusion Detection and Prevention Systems (IDPS), Identity and Access Management (IAM), Encryption Techniques and Zero-Trust Architecture.	9
4	Monitoring, Troubleshooting, and Optimizing Cloud Networks :- Network Monitoring in Cloud: Tools for Cloud Network Monitoring, Setting Up Alerts and Dashboards. Troubleshooting Cloud Networks: Common Cloud Networking Issues and Solutions, Using Diagnostic Tools (e.g., Traceroute, Ping). Network Traffic Analysis and Optimization: Analyzing Traffic Patterns in Cloud Networks, Performance Tuning and Cost-Effective Network Configuration. Automation in Cloud Network Management: Automating Network Configuration and Management, Using Infrastructure as Code (IaC) Tools.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Fundamental Networking Concepts and Cloud Computing Basics.	K2
CO2	Explain IP Addressing and Subnetting Techniques.	K2
CO3	Apply Networking Protocols and Cloud Connectivity Solutions.	K3
CO4	Illustrate Cloud Networking Components and Security Measures	K2
CO5	Troubleshooting and Optimization Techniques in Cloud Networks.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networking: A Top-Down Approach	James F. Kurose and Keith W. Ross	Pearson Publications	Eight Edition, 2017.
2	Cloud Computing: Concepts, Technology & Architecture	Thomas Erl, Ricardo Puttini, and Zaigham Mahmood	Prentice Hall Publications	First edition, 2013.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud Networking: Understanding Cloud-based Data Center Networks	Gary Lee and Lee Hwee Kuan	CRC Press	First edition, 2017.
2	Network Security Essentials: Applications and Standards	William Stallings	Pearson Publications	Sixth edition, 2020.
3	AWS Certified Advanced Networking Official Study Guide: Specialty Exam	Brad Bulger, Ather Khan, and Stephen Cole	Wiley Publications	First edition, 2020.

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/fErDcUtd8fA?si=vk5rYduwokgAqUMh
2	https://youtu.be/3NDhETVfrp0?si=MyOfYaRDJRJ0gn9F
3	https://youtu.be/RWgW-CgdIk0?si=HN9mHIo4w9-J4IaJ
4	https://youtu.be/YmYWevNdcik?si=8dO1vCGjO1yPQ8XE

SEMESTER S5

BLOCKCHAIN AND CRYPTOCURRENCY

Course Code	25CCT522	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
2. To create cryptocurrencies and give a strong technical understanding of Blockchain technologies with an in-depth understanding of applications, open research challenges, and future directions.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	INTRODUCTION TO BLOCKCHAIN Block chain- Public Ledgers, Blockchain as Public Ledgers – Block in a Blockchain, Transactions-The Chain and the Longest Chain – Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree	9
2	BITCOIN AND CRYPTOCURRENCY A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay	9
3	BITCOIN CONSENSUS Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn -	9

	Proof of Elapsed Time – Bitcoin Miner, Mining Difficulty, Mining Pool- Permissioned model and use cases.	
4	HYPERLEDGER FABRIC & ETHEREUM Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity. BLOCKCHAINAPPLICATIONS. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc- Case Study.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand emerging abstract models for Blockchain Technology	K2
CO2	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.	K4
CO3	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.	K2
CO4	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application	K3
CO5	Understand the applications of blockchain in various fields.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									3
CO2	2	3	2									2
CO3	3	2	2									2
CO4	2	3	2									2
CO5	3	2	2									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mastering Blockchain: Inner workings of blockchain, from cryptography and decentralized identities, to DeFi, NFTs and Web3, 4th Edition	Bashir and Imran	Kindle Edition	2023
2	“Mastering Bitcoin: Unlocking Digital Cryptocurrencies”,	Andreas Antonopoulos Drescher	O’Reilly	2023
3	Handbook of Research on Blockchain Technology		Elsevier Inc. ISBN: 978012819816	2020.

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/fu8SFfO948A?feature=shared
2	https://www.youtube.com/live/hixM4u7ep58?feature=shared
3	https://youtu.be/fw3WkySh_Ho?feature=shared
4	https://youtu.be/sro__4PhmKg?feature=shared

SEMESTER S5

AI IN CYBER SECURITY

Course Code	25CCT523	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PECCT413 Introduction to AI and ML	Course Type	Theory

Course Objectives:

1. Understand the application of AI in various aspects of Cyber Security.
2. Identify and describe Machine Learning techniques used in threat detection.
3. Utilize AI-based tools for cybersecurity tasks.
4. Apply AI-driven data analysis to identify and mitigate cyber threats.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	AI in Cyber Security Role of AI in Cyber Security: Introduction to the role of AI in cybersecurity: how AI is transforming cyber defences, Discussion on the current state of cyber threats and how AI can mitigate them Review of Basic Cyber Threats: Overview of basic cyber threats: malware, phishing, DDoS attacks, etc. Introduction to AI Tools in Cyber Security: Overview of commonly used AI tools (e.g., antivirus software, intrusion detection systems) Case Studies: AI Applications in Cyber Security Case Study 1: How AI stopped a major phishing campaign (e.g., Google's Safe Browsing) Case Study 2: Using AI to detect anomalies in network traffic (e.g., DARPA's Cyber Grand Challenge)	9

2	Machine Learning in Threat Detection Application of Supervised Learning in Threat Detection: Introduction to supervised learning: concepts and algorithms, Practical examples of supervised learning in detecting malware Introduction to Unsupervised Learning Techniques for Anomaly Detection: Overview of unsupervised learning: clustering, anomaly detection Case Study: Unsupervised learning in detecting insider threats (e.g., detecting insider trading in financial institutions)	9
3	AI-Based Tools and Techniques in Cyber Security Overview of AI-Powered Cybersecurity Tools: Introduction to advanced AI-powered tools: firewalls, intrusion detection systems, Discussion on how AI enhances traditional cybersecurity tools, AI-based firewalls and their real-world applications Introduction to AI-Driven Data Analysis Techniques: Basic concepts of AI-driven data analysis in cybersecurity Case Study: How AI-driven data analysis thwarted a cyber-attack (e.g., IBM's Watson in Cybersecurity)	9
4	Ethical Considerations and Challenges in AI for Cyber Security Ethical Implications of AI in Cyber Security: Ethical issues surrounding AI in cybersecurity (privacy, bias, etc.) Challenges in Implementing AI for Cyber Security: Technical challenges in AI-based cybersecurity (data quality, model robustness), Future Trends and Ethical Balances in AI and Cyber Security, Emerging trends in AI for cybersecurity Case Study: Privacy concerns with AI-driven surveillance (e.g., AI in facial recognition by law enforcement)	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To describe the role of AI in modern cybersecurity.	K2
CO2	To explain the application of supervised learning in threat detection.	K2
CO3	To analyze real-world applications of AI in virus detection and intrusion prevention.	K3
CO4	To explain the ethical implications of AI in cybersecurity, including privacy and bias issues.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1						1			
CO2	3	1	1						1			
CO3	3	2	2	1	1				1			
CO4	3	2				1		1	1			

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Artificial Intelligence in Cyber Security: Theories and Applications	Himanshu Upadhyay, Steven Lawrence Fernandes, Tarun Kumar Sharma, Tushar Bhardwaj	Springer International Publishing	2023
2	ARTIFICIAL INTELLIGENCE IN CYBER SECURITY	Rahul Neware Khaja Mannanuddin, Mukesh Madanan, Dr. Shikha Gupta	Book Rivers	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Artificial Intelligence in Cybersecurity	Leslie F. Sikos	Springer International Publishing	2018
2	Artificial Intelligence for Cybersecurity: Techniques, Challenges and Research	Mark Stamp	Springer International Publishing	2022
3	Machine Learning and Security: Protecting Systems with Data and Algorithms	Clarence Chio, David Freeman	O'Reilly Media	2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	Cyber Security and Privacy by Prof. Saji K Mathew (NPTEL)
2	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha
3	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha
4	Applied Accelerated Artificial Intelligence By Prof. Satyajit Das, Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof.Ashrut Ambastha

SEMESTER S5

ADVANCED INDUSTRIAL CYBER SECURITY

Course Code	25CCT524	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CCT414 FUNDAMENTALS OF INDUSTRIAL CONTROL SYSTEM SECURITY	Course Type	Theory

Course Objectives:

1. Enables the learners to understand the advanced concepts of Network Security and Endpoint Security.
2. Enables the learners to apply the best practices in each phase of SDLC and gain an insight on data classification and data loss prevention.
3. Enables learners to manage the full life cycle of digital entities, gain skills in deploying SIEM systems and apply threat intelligence to improve organizational security.
4. Enables the learners to understand the Compliance and regulatory controls and gain knowledge on emerging technologies related to industrial cyber security.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Network Security Controls : Firewalls - Types of Firewalls, Configuration of Firewalls, Intrusion Detection and Prevention Systems (IDPS), Virtual Private Networks (VPNs), Network Segmentation.	9

	Endpoint Security : Antivirus and Antimalware, Endpoint Detection and Response (EDR), Patch Management, Device Encryption.	
2	Application Security Controls: Secure Software Development Lifecycle (SDLC), Code Review And Static Analysis, Web Application Firewalls (WAF), Database Security. Data Protection Controls: Data Classification and Handling, Data Loss Prevention (DLP), Encryption (At Rest, In Transit),Backup and Recovery.	9
3	Identity and Access Management (IAM) : Identity Lifecycle Management, Single Sign-On (SSO),Federation and Trust Models, Privileged Access Management (PAM). Security Monitoring and Incident Response: Security Information and Event Management (SIEM),Threat Intelligence, Incident Response Planning,Forensics and Post-Incident Analysis	9
4	Compliance and Regulatory Controls: General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), Sarbanes-Oxley Act (SOX), Payment Card Industry Data Security Standard (PCI DSS). Emerging Trends and Technologies: Zero Trust Architecture, Artificial Intelligence in Cyber Security, Block chain for Security, Quantum Computing Implications. Case Study: Analysis of Real-World Cyber security Incidents	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Able to configure firewall rules and policies and identify different types of malware.	K2
CO2	Integrate security practices into each phase of SDLC and apply the principles of encryption for data protection	K3
CO3	Design and implement Identity management processes and understand the role of SIEM systems in analysing security events.	K3
CO4	Integrate Threat Intelligence into security operations and conduct post-incident analysis to determine the root cause of security incidents.	K3
CO5	Understand the compliance and regulatory controls and gain knowledge on emerging technologies related to industrial cyber security.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	1	1				1
CO2	3	2	2	2	1	1	1	1				1
CO3	3	2	2	2	1	1	1	1				1
CO4	3	2	2	2	1	1	1	1				1
CO5	3	2	2	2	1	1	1	1				1

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Network Security Essentials: Applications and Standards.	William Stallings	Pearson	6 th Edition, 2016
2	Network Intrusion Detection and Prevention: Concepts and Practices	Ali A Ghorbani, Wei Lu, Mahabod Tavallaee	Springer-Verlag New York Inc.	1 st Edition, 2010
3	Malware Analyst's Cookbook and DVD: Tools and Techniques for fighting malicious code	Michael Ligh, Steven Adair, Blake Heartstein	Wiley	1 st Edition, 2010
4	Software Security: Building Security In	Gary McGraw	Addison-Wesley	1 st Edition, 2006
5	Identity and Access Management :Business Performance through Connected Intelligence	Ertem Osmanoglu	Syngress	1 st Edition, 2013
6	Zero Trust Networks: Building Secure systems in Untrusted Networks	Evan Gilman, Doug Barth	O'Reilly	1 st Edition 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Web Application Security: Exploitation and Countermeasures for Modern Web Applications	Andrew Hoffman	Orielly and Associates Inc.	2 nd Edition, 2020
2	Security Information and Event Management Implementation	David Miller, Shon Harris, Allen Harper, Stephen Wandyke, Chris Blask	McGraw Hill Education	2 nd Edition, 2010
3	Block chain Basics : A Non-Technical Introduction in 25 steps	Daniel Drescher	Apress	1 st edition, 2017

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	http://www.digimat.in/nptel/courses/video/106105031/L40.html
2	https://nptel.ac.in/courses/128106006
3	https://onlinecourses.nptel.ac.in/noc24_cs85/preview
4	https://onlinecourses.nptel.ac.in/noc24_cs121/preview http://www.digimat.in/nptel/courses/video/106104220/L01.html

SEMESTER S5

SOFTWARE PROJECT MANAGEMENT

(Common CS/CD/CM/CR/CA/AD/AM)

Course Code	25CST521	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CST411	Course Type	Theory

Course Objectives:

1. To learn the techniques to effectively plan, manage, execute, and control projects within time and cost targets with a focus on Information Technology and Service Sector.
2. To learn agile project management techniques such as Scrum and DevOps.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Project scheduling and feasibility study : - Project Overview and Feasibility Studies - Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal; Project Scheduling - Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.	8
2	Resource Scheduling, Cost Control and Project management Features :- Cost Control and Scheduling - Project Cost Control (PERT/Cost), Resource Scheduling & Resource Levelling; Project Management Features - Risk Analysis, Project Control, Project Audit and Project Termination.	8

3	Agile Project Management :- Agile Project Management - Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL);. Other Agile Methodologies - Introduction to XP, FDD, DSDM, Crystal.	9
4	Scrum and DevOps in project management :- Scrum - Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study; DevOps - Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand how effectively plan, and schedule projects within time and cost targets	K2
CO2	Apply project estimation and evaluation techniques to real world problem	K3
CO3	Discuss different Agile Project Methodologies	K2
CO4	Apply various SCRUM practices in project management.	K3
CO5	Demonstrate the techniques used in DevOps.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3								2	2
CO2	3	3	3								2	2
CO3	3	3	3								2	2
CO4	3	3	3								2	2
CO5	3	3	3								2	2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Succeeding with Agile: Software Development Using Scrum	Mike Cohn	Addison-Wesley	1/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Agile Product Management with Scrum	Roman Pichler	Addison-Wesley	1/e, 2010
2	Agile Project Management with Scrum	Ken Schwaber	Microsoft Press	1/e, 2004

Video Links (NPTEL, SWAYAM...)	
No.	Link ID
1	https://archive.nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs70/
2	https://www.youtube.com/watch?v=TPEgII1OilU
3	https://www.youtube.com/watch?v=7Bxdds2siU8

SEMESTER S5

DATA MINING

(Common to CS/CD/CM/CA/AM)

Course Code	25CST525	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide a thorough understanding of the key processes and concepts involved in data mining and data warehousing within application domains
2. To enable students to understand the different data preprocessing techniques, fundamentals and advanced concepts of classification, clustering, association rule mining, text mining and web mining, and apply these techniques in real-world scenarios

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	<i>Data Mining Fundamentals :-</i> Data Mining - concepts and applications, Knowledge Discovery in Database Vs Data mining, Architecture of typical data mining system, Data Mining Functionalities Data warehouse - Differences between Operational Database Systems and Data Warehouses, Multidimensional data model- Warehouse schema, OLAP Operations, Data Warehouse Architecture	10
2	<i>Data Preprocessing :-</i> Data Preprocessing - Need of data preprocessing, Data Cleaning- Missing values, Noisy data, Data Integration and Transformation	11

	Data Reduction - Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization and concept hierarchy generation.	
3	<i>Classification And Clustering :-</i> Classification - Introduction, Decision tree construction principle, Information Gain, Gini index, Decision tree construction algorithm - ID3, Neural networks, back propagation, Evaluation measures - accuracy, precision, recall, F1 score Clustering - Introduction to clustering, distance measures, Clustering Paradigms, Partitioning Algorithm - k means, Hierarchical Clustering, DBSCAN	11
4	Association Rule Analysis And Advanced Data Mining :- Association Rule Mining - Concepts, Apriori algorithm, FP Growth Algorithm Web Mining - Web Content Mining, Web Structure Mining- Page Rank, Web Usage Mining- Preprocessing, Data structures, Pattern Discovery, Pattern Analysis Text Mining - Text Data Analysis and information Retrieval, Basic measures for Text retrieval, Text Retrieval methods, Text Indexing Technique	12

Criteria for Evaluation(Evaluate and Analyse): 20 marks

Students must be asked to identify problems involving large datasets and identify the right solution from the concepts already learned. A comparison of the results with a similar approach also need to be performed to assess the Knowledge Level 5.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• 2 questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. • Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the key process of data mining and data warehousing concepts in application domains.	K2
CO2	Apply appropriate pre-processing techniques to convert raw data into suitable format for practical data mining tasks	K3
CO3	Illustrate the use of classification and clustering algorithms in various application domains	K3
CO4	Comprehend the use of association rule mining techniques	K3
CO5	Explain advanced data mining concepts and their applications in emerging domains	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	3	3	3	3	2							2
CO3	3	3	3	3	2							2
CO4	3	3	3	3	2							2
CO5	2	2										2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data Mining Concepts and Techniques	Jaiwei Han, Micheline Kamber	Elsevier	3/e, 2006
2	Data Mining: Introductory and Advanced Topics	Dunham M H	Pearson Education	1/e, 2006

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Data Mining	Pang-Ning Tan, Michael Steinbach	Addison Wesley	1/e, 2014
2	Data Mining: Concepts, Models, Methods, and Algorithms	Mehmed Kantardzic	Wiley	2/e, 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/ykZ-_UGcYWg?si=qiqynQyjI1sNNiHE
2	https://youtu.be/NSxEiohAH5o?si=ZIJHMiRvpFcNQNMA
3	https://youtu.be/VsYKqOokgaE?si=rgndBZqpzB29LUGg
4	https://youtu.be/N_whCVtfL9M?si=VPMH9NP4vdAaiuPe

SEMESTER S5

CRYPTOGRAPHY LAB

Course Code	25CCL507	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

1. **Develop Practical Skills in Cryptographic Techniques:** To equip students with hands-on experience in implementing and analyzing various cryptographic algorithms, including classical ciphers, symmetric encryption, and asymmetric encryption techniques.
2. **Enhance Understanding of Cryptographic Principles and Applications:** To enable students to demonstrate and apply fundamental cryptographic principles in real-world scenarios, ensuring data integrity, confidentiality, and authentication through practical coding exercises.
3. **Foster Proficiency in Secure Communication and Memory Management:** To cultivate students' ability to design and implement secure communication protocols and to simulate memory allocation and garbage collection using linked lists, integrating cryptographic methods with effective memory management techniques.

Expt. No.	Experiments
1	Represent a string (char pointer) with a value "Hello world". The program should XOR each character in this string with 0 and displays the result.*
2	Represent string (char pointer) with a value "Hello world" The program should AND, OR, and XOR each character in this string with 127 and display the result.
3	Perform encryption and decryption using the following algorithms* a. Ceaser cipher b. Substitution cipher c. Hill Cipher
4	Implementation of Encryption and Decryption using DES*
5	Implementation of RSA Encryption Algorithm

6	Implementation of Hash Functions*
7	Implementation of Blowfish algorithm logic*
8	Implement the Diffie-Hellman Key Exchange mechanism
9	Implement RC4 logic using Java*
10	Encrypt the text “Hello world” using Blowfish.
11	Implement the SIGNATURE SCHEME –Digital Signature Standard*
12	Implement LSB Steganography.

PRACTICE QUESTIONS

1. Write a C program that contains a string (char pointer) with a value “Helloworld”. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value “Hello world”. The program should AND, OR, and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms
 - a. Caesar cipher
 - b. Substitution cipher
 - c. Hill Cipher
4. Write a C/JAVA program to implement DES Encryption and Decryption
5. Write a C/JAVA program to implement RSA Encryption Algorithm
6. Write a C/JAVA program to implementation of Hash Functions.
7. Write a C/JAVA program to implement the Blowfish algorithm logic.
8. Write the RC4 logic in Java Using Java cryptography; encrypt the text Hello world using Blowfish. Create your own key using Java key tool.
9. Write a C/JAVA program to implement the Diffie-Hellman Key Exchange mechanism
10. Implement the SIGNATURE SCHEME –Digital Signature Standard
11. Embed a short text message (up to 8 characters) into the least significant bits of the image's pixel data. Read the modified image and extract the hidden message.

**Course Assessment Method (CIE:
50 marks, ESE: 50 marks)**

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Students will implement various classical and modern cipher techniques to understand the process of securing information.	K3
CO2	Students will code and distinguish between symmetric and asymmetric cryptographic methods, gaining practical knowledge of both types.	K3
CO3	Students will explore and implement different encryption techniques and message authentication codes (MACs) to ensure data integrity and security.	K3
CO4	Students will write programs to implement the DES (Data Encryption Standard) and RSA (Rivest-Shamir-Adleman) algorithms, understanding their mechanisms and uses.	K3
CO5	Students will create a program using linked lists to simulate memory allocation and garbage collection, applying data structure concepts to memory management.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1		1				1
CO2	3	3	3	2	1	1		1				1
CO3	3	3	3	2	1	1		1				1
CO4	3	3	3	2	1	1		1				1
CO5	3	3	3	2	1	1						1

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Applied Cryptography: Protocols, Algorithms and Source Code in C	Bruce Schneier	Wiley	2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://cse29-iiith.vlabs.ac.in/ (AICTE Virtual Labs)

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER S5

NETWORK AND SYSTEM SECURITY LAB

Course Code	25CCL508	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None / Course Code	Course Type	Lab

Course Objectives:

1. Familiarize tools to prevent latest threats
2. Analyze the network traffic using sniffing tools.
3. Use network scanning tools
4. Familiarize various Steganography tools
5. Use tools for Penetration testing

Expt. No.	Experiments
1	Preventing PC against latest threats using Windows Defender.
2	Data hiding using Xiao Steganography
3	Website mirroring using HTTrack
4	Monitor, capture and analyze network packets using Wireshark.
5	Network mapping and analysing. Using Nmap
6	Port Scanning using Angry IP Scanner or Advanced IP Scanner.
7	Penetration testing and Vulnerability Scanning using Burp Suit.
8	Password Cracking-Use John The ripper /hydra

PRACTICE QUESTIONS

1. You need to protect a Windows computer from malware and viruses without installing any third-party software. Which built-in tool can you use to scan and remove malicious threats?
2. A user reports that their computer is behaving strangely, and you suspect malware. Which default Windows tool would you use to perform a quick or full system scan to identify and eliminate the threat?
3. You need to troubleshoot network latency issues by examining the timing of packet transmissions. Which tool will help you capture and analyze the packet flow to identify the cause of the delay?
4. To verify the integrity of communication between two endpoints on your network, you want to capture and analyze the packets being exchanged. Which tool would be best suited for this task?
5. You need to scan a network to discover active devices and identify open ports on each device. Which tool can you use to perform this network discovery and security auditing?
6. You need to create an offline copy of a website for analysis and reference. Which tool can you use to download the entire site, including HTML, images, and other files?
7. You want to back up a website's content and structure to ensure you have a local copy in case the site becomes unavailable. Which tool should you use to accomplish this task efficiently?
8. You need to hide sensitive data within an image file to ensure it remains undetected by unauthorized users. Which tool would you use to embed and later extract this hidden information?
9. During a network inventory process, you want to quickly discover and document all the IP addresses currently in use. Which tool would help you perform this task efficiently?
10. To test the security of a web application, you need to perform automated vulnerability scanning and manual testing for common web application flaws. Which tool provides integrated features for both types of testing?

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by External Examiner: The external examiner shall endorse the record*

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarize tools to prevent latest threats	K3
CO2	Analyze the network traffic using sniffing tools	K3
CO3	Use network scanning tools	K3
CO4	Familiarize various Steganography tools	K3
CO5	Use tools for Penetration testing	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3			2				2
CO2	2	2	2	2	3			2				2
CO3	2	2	3	2	3			2				2
CO4	2	2	3	2	3			2				2
CO5	2	2	3	2	3			2				2

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER 6

**COMPUTER SCIENCE AND ENGINEERING
CYBER SECURITY**

SEMESTER S6
COMPILER DESIGN
(Common to CS/CD/CU/CC/CN/CB)

Course Code	25CST601	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PCCST302	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of the compiler construction process through its various phases viz. lexical analysis, parsing, semantic analysis, code generation, and optimization.
2. To introduce compiler construction tools like Lex and YACC and use them in lexical analysis and parsing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Compiler Structure, Overview of Translation: The Front End; The Optimizer; The Back End. Scanners - Recognizing Words, Regular Expressions, From Regular Expression to Scanner: FSA (Brush-up only), Implementing Scanners <i>Hands-on: Recognizing Words with Lex, Regular Expressions in Lex</i>	6
2	Parsing - Introduction, Expressing Syntax Top-Down Parsing - Transforming A Grammar: Eliminating Left Recursion; Backtrack-free Parsing; Left-Factoring To Eliminate Backtracking, Recursive Descent Parsers, Table-Driven LL(1) Parsers	10
3	Bottom-Up Parsing - Shift Reduce Parser, The LR(1) Parsing Algorithm, Building LR(1) Tables, Errors in the Table Construction,	16

	Reducing the Size of LR (1) Tables. Hands-on: Building a calculator with YACC Intermediate Representations: An IR Taxonomy, Graphical IRs - Syntax-Related Trees, Graphs; Linear IRs - Stack-Machine Code - Three-Address Code - Representing Linear Codes Syntax-Driven Translation: Introduction, Translating Expressions, Translating Control-Flow Statements	
4	Code generation: Code Shape - Arithmetic Operators, Boolean and Relational Operators, Control-Flow Constructs (Conditional Execution, Loops and Iteration, Case Statements only), Procedure Calls Code Optimization - Introduction, Opportunities for Optimization, Scope Of Optimization Local Optimization: Local Value Numbering, Tree-Height Balancing Regional Optimization: Superlocal Value Numbering, Loop Unrolling Global Optimization: Finding Uninitialized Variables with Live Sets, Global Code Placement	14

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use lexical analysis techniques to build a scanner for a given language specification. (Cognitive Knowledge Level: Apply)	K3
CO2	Construct parse trees for input programs using parsing algorithms and detect syntactic errors. (Cognitive Knowledge Level: Apply)	K3
CO3	Develop semantic analysis techniques to check program correctness. (Cognitive Knowledge Level: Apply)	K3
CO4	Build intermediate code representations by applying intermediate code generation techniques. (Cognitive Knowledge Level: Apply)	K3
CO5	Optimize generated code using code optimization strategies to improve performance. (Cognitive Knowledge Level: Apply)	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		3							2
CO2	3	3	3		3							2
CO3	3	3	3		3							2
CO4	3	3	3		3							2
CO5	3	3	3		3							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering a Compiler	Keith D. Cooper, Linda Torczon	Elsevier Science	3/e, 2023
2	Lex and YACC	John R. Levine, Tony Mason, Doug Brown	O' Reilly	2/e, 1992

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compilers – Principles Techniques and Tools	Aho A.V., Ravi Sethi and D. Ullman.	Addison Wesley,	2/e, 2010.
2	Compiler Construction - Principles and Practice	Kenneth C Louden	Thomson Learning	1/e, 2007
3	Compiler Design in C	Allen Holub	Prentice-Hall software series	1/e, 1990
4	Modern Compiler Implementation in C	Andrew W. Appel	Cambridge University Press	2/e, 2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1-4	https://archive.nptel.ac.in/courses/106/105/106105190/

SEMESTER S6

CYBER FORENSICS

Course Code	25CCT602	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand about Computer Forensics and the procedures for investigations and incident response.
2. To study about data acquisition and to have an understanding of different forensic acquisition tools.
3. To explore the various cyber threats, attacks and the different anti forensic techniques.
4. To study the theory behind Network Forensics, Mobile Forensics and various types of Forensics.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Cyber Forensics and Investigations: Introduction- Computer Forensic Investigations - Forensics Investigation Process -Preparing for computer investigations, understanding Public and private investigations. Data Acquisition - storage formats for digital evidence, determining the best acquisition method -Forensic Protocol for Evidence Acquisition - Digital Forensics Standards and Guidelines – Incident Response stages -Digital Evidence – identification, collection, processing, seizing documenting and storing - contingency planning for image acquisitions.	9
2	Cyber Forensics Tools and Types of Forensics: Cyber Forensics Tools -Computer Forensics software and hardware tools - Open Source and Proprietary -Challenges in Cyber Forensics, Skills	9

	Required to Become a Cyber Forensic Expert- Physical Requirements of a Cyber forensics Lab, Types of Cyber forensics. File System Forensics-Working with windows and CLI systems- file systems, exploring Microsoft file structures, examining FAT and NTFS disks, whole disk encryption, the windows registry, Microsoft start up tasks- Windows7, Windows 8, Windows 10- Examining UNIX and LINUX disk structures and boot processes, understanding Disk drives, Solid State storage devices.	
3	OS and Network Forensics Windows Forensics-Live Response: Data Collection- Introduction , Locard's Exchange Principle, Order of Volatility - Volatile and Non Volatile Data Live-Response Methodologies: Data Analysis, Windows Memory Analysis, Rootkits and Rootkit detection. Linux Forensics: Live Response- Data Collection- Data Analysis- Log Analysis, Keyword Searches, User Activity, Network Connections, Running Processes, Open File Handlers, The Hacking Top Ten and Reconnaissance Tools. Network Forensics: The OSI Model, Forensic Footprints, Seizure of Networking Devices, Network Forensic Artifacts, ICMP Attacks, Drive-By Downloads, Network Forensic Analysis Tools, Network Log analysis, Case Study: Wireshark. Web Attack Forensics: OWASP Top 10, Web Attack Tests, Penetration Testing. Mobile Device Forensics and Internet of Anything- Cloud Forensics.	9
4	Cyber Security and Anti Forensics Cyber Security: Cybercrimes, Types of Cybercrimes –Cyber Security Steps taken to protect ICT and prevent Misuse of Internet- IT Act 2000 and amendments- Email and Social Media Investigations-. Cyber Technology- Technological/Governance/Judicial/Legal Aspects and perspectives of Cyber Forensics/Security. Cyber-attack Frameworks-Mitre Framework-Crypto currency.	9

	Anti-Forensics Anti-forensic Practices - Data Wiping and Shredding- Data Remanence, Degaussing, Case Study: USB Oblivion, Eraser - Trail Obfuscation: Spoofing, Data Modification, Case Study: Timestamp – Encryption, Case Study: VeraCrypt, Anti-forensics Detection Techniques	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts in cyber forensics, forensics Investigation Process and the usage of Cyber Forensics Tools in investigations	K2
CO2	Infer the basic concepts of file systems, its associated attribute definitions	K2
CO3	Utilize the methodologies used in memory analysis and network analysis for detection of artifacts	K3
CO4	Explain the basic concepts in cyber security and study the essence of IT Act.	K2
CO5	Summarize anti forensics practices and data hiding methods.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2				3						2
CO2	2	2										2
CO3	2	2	3	3	3							2
CO4	2	2	3	3	3							2
CO5	2	2			2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Guide to computer forensics and investigations	Bill Nelson, Amelia Philipps and Christopher Steuart	Cengage	6 th Edition 2020
2	File System Forensic Analysis	Brian Carrier	Pearson Education, Inc.	1 st Edition, 2005
3	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress	2 nd Edition, 2009
4	Unix and Linux Forensic Analysis DVD Toolkit	Chris Pogue , Cory Altheide, Tode Haverkos	Syngress	1 st Edition, 2008
5	Fundamentals of Network Security	E. Maiwald	McGraw-Hill	1 st Edition, 2017
6	Network Security Essentials Applications and Standards	William Stallings	Pearson Education	6 th Edition, 2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
I	Information Security and Cyber Forensics-- NPTEL/SWAYAM By Prof. Pratosh Bansal Devi Ahilya Vishwavidyalaya, Indore
II/III	Digital Forensics-- NPTEL/SWAYAM By Dr. Jeetendra Pande Uttarakhand Open University, Haldwani
IV	Cyber Security and Privacy By Prof. Saji K Mathew IIT Madras

SEMESTER S6

CLOUD INFRASTRUCTRE AND SYSTEMS

Course Code	25CCT631	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CCT602	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of cloud computing concepts and infrastructure.
2. To explore various cloud service models and deployment models.
3. To understand the security challenges and solutions in cloud computing environments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Traditional computing: Limitations, Overview of Computing Paradigms: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing, NIST reference Model, Basic terminology and concepts, Cloud characteristics, benefits and challenges, Cloud delivery (service) models: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), XaaS (Anything-as-a-service), Cloud deployment models: Public cloud, Community cloud, Private cloud, Hybrid cloud, Open Cloud Services.	9
2	Basic Terms and Concepts in Security, Threat Agents, Cloud Security Threats, Identity Management and Access Control, Cloud Security Working Groups, Elements of Cloud Security Model, Cloud Security Reference Model, Examining Cloud Security against Traditional Computing	9

3	Introduction to AWS, AWS history, AWS global Infrastructure, AWS services, AWS ecosystem, comparison of AWS, Azure and Google cloud.	9
4	Security Management in the Cloud Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS, Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To provide students with a comprehensive understanding of cloud computing concepts and infrastructure	K2
CO2	To explore various cloud service models and deployment models	K2
CO3	To understand the security challenges and solutions in cloud computing environments	K2
CO4	To understand fundamental of Identity and Access Management and compliance	K3
CO5	Identify the industry security standards, regulatory mandates, audit policies and compliance requirements for Cloud based infrastructures	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	3	2									2
CO3	3	2										2
CO4	3	2	2	2	2							2
CO5	3	2			2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud computing	Bhowmik, S.	Cambridge University Press, 2017	First edition ,2017
2	Cloud Computing Concepts, Technology & Architecture	Thomas, E., Zaigham, M., Ricardo, P	Prentice Hall,	First Edition,2013
3	Cloud Security: A Comprehensive Guide to Secure Cloud Computing	Ronald L. Krutz, Russell Dean Vines	Wiley Publishing, 2010	First edition ,2010
4	Cloud Security and Privacy	Tim Mather, SubraKumaraswamy, and ShahedLatif	O'Reilly Media, Inc., 2009	First edition 2009

SEMESTER S6

CRYPTOGRAPHIC ALGORITHMS IN BLOCK CHAIN

Course Code	25CCT632	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	CCT 412	Course Type	Theory

Course Objectives:

1. To understand building blocks of Blockchain.
2. The course introduces the cryptographic principles behind blockchain

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Foundations of Blockchain Blockchain Architecture –Challenges –Applications –Blockchain Design Principles -The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - peer-to-peer network – Abstract Models - GARAY model - RLA Model-Proof of Work (PoW) -Proof of Stake (PoS) based Chains - Hybrid models.	7
2	Fundamentals of Cryptography Introduction to Cryptography, Symmetric cryptography – AES. Asymmetric cryptography – RSA. Elliptic curve cryptography, Digital signatures – RSA digital signature algorithms. Secure Hash Algorithms – SHA-256. Applications of cryptographic hash functions – Merkle trees, Distributed hash tables.	7
3	Crypto Primitives, Securing and Interconnecting Public and Private Block Chains Hash Function and Merle Tree-Security Properties-Security Considerations for block chain Digital Signature-Public Key Cryptography-Bitcoin	7

	blockchain incentive structures- Nash Equilibriums- evolutionary stable strategies,-and Pareto efficiency (game theory) Weaknesses and news Points of Failure, Mitigation Methods, Redundancies and fall-back methods.	
4	Blockchain Protocols Ethereum tokens –Augur -Golem -Understanding Ethereum tokens -App Coins and Protocol Tokens - Blockchain Token Securities Law Framework - Token Economy - Token sale structure - Ethereum Subreddit.	6

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand Blockchain ecosystem and its services in real world sceneries.	K2
CO2	Distinguish between Symmetric cryptography and asymmetric cryptography.	K4
CO3	Explain the working of AES algorithm.	K4
CO4	Understanding the methods for Securing and Interconnecting Public and Private Block Chains	K2
CO5	Acquaint the protocol and assess their computational requirements	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		3	1							2
CO2	2	2		3	1				2			2
CO3	2	2		3	1				2			2
CO4	2	2		3	1				2			2
CO5	2	2		3	1			3				2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Blockchain enabled applications	Dhillon, V., Metcalf, D., and Hooper, M	CA: Apress, Berkeley	1st Edition, 2017
2	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more	Imran Bashir	Packt Publishing	Third edition, 2020

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Blockchains, digital assets, smart contracts, decentralized autonomous organizations	Diedrich, H. Ethereum	Wildfire publishing, Sydney.	1st Edition, 2016
2	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	Wiley Publications	1st Edition, 2020
3	Blockchain Technology	Chandramouli Subramanian, Asha A George, et al	Universities Press (India) Pvt. Ltd	First edition, August 2020
4	Distributed Ledger Technology: The Science of the Blockchain	Wattenhofer, R. P	Createspace Independent Pub, Scotts Valley, California, US.	2 nd Edition

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/mzPoUjQC4WU
2	https://youtu.be/LjEZzYe5uOo?feature=shared
3	https://youtu.be/3FnEwnOpo_k?feature=shared
4	https://youtu.be/v1MSq7m7lzA?feature=shared

SEMESTER S6

AI AND ML IN CYBER SECURITY DEFENCE

Course Code	25CCT633	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CCT413 Introduction to AI and ML 25CCT523 AI in Cyber Security	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of the importance, challenges, and promises of AI in the cybersecurity landscape.
2. To familiarize students with various machine learning techniques and their applications within the cybersecurity domain, including anomaly detection and intrusion detection.
3. To introduce students to generative AI concepts, algorithms, and models, and explore their applications in cybersecurity, including threat detection and incident response.
4. To equip students with the knowledge to identify potential security risks associated with AI and generative AI, and to develop best practices for securing AI systems in cybersecurity.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction: Role of AI in Cyber Security and Security Framework Review of Artificial Intelligence in Cyber Security: Definition and Importance, Challenges and promises, Security Threats of Artificial Intelligence: Types and Examples Machine Learning in Cyber Security Introduction to Machine Learning: Concepts and Terminology, Applications of Machine Learning in the Cyber Security Domain , Machine Learning Tasks and Approaches: Supervised vs. Unsupervised Learning Anomaly Detection Techniques in Cybersecurity,	8

	Privacy Preserving Nearest Neighbour Search; Techniques and Applications, Machine Learning Applied to Intrusion Detection	
2	Fundamentals of Generative AI: Concepts, Algorithms, and Models; Generative AI Techniques: Variational Autoencoders (VAEs), Generative Adversarial Networks (GANs), Transformer-Based Models Applications of Generative AI in Various Domains: Text Generation, Image Synthesis Case Study: Successful Generative AI Applications and their Impact	10
3	Generative AI for Cybersecurity Overview of Cybersecurity Challenges and the Potential of Generative AI: Applications of Generative AI in Cybersecurity; Anomaly Detection, Threat Hunting, Vulnerability Analysis Generative AI for Automated Incident Response and Mitigation Case Study: Generative AI in Real-World Cybersecurity Scenarios Generative AI Security Risks and Challenges Potential Security Risks Associated with Generative AI: Data Poisoning, Model Inversion, Adversarial Attacks	9
4	Overview of Generative AI Applications in Cybersecurity Defence: Predictive Analytics for Threat Detection Using Generative AI, Automated Security Patch Generation and Vulnerability Management, Strengthening Encryption Protocols Case Study: Real-World Applications of Generative AI in Cybersecurity defence, Best Practices for Securing Generative AI Systems, Future Trends in Generative AI for Cybersecurity defence	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To explain the significance of AI in cybersecurity, including its challenges and potential threats.	K2
CO2	To identify and apply machine learning techniques relevant to cybersecurity tasks, such as anomaly detection and intrusion detection.	K3
CO3	To evaluate the effectiveness of generative AI techniques in addressing cybersecurity challenges, including incident response and threat mitigation.	K4
CO4	To assess security risks related to AI systems and propose best practices for securing generative AI applications in cybersecurity.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	2	3	2									
CO3	2	2	1									
CO4	3	2	2					1				

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Artificial Intelligence in Cyber Security: Theories and Applications	Himanshu Upadhyay, Steven Lawrence Fernandes, Tarun Kumar Sharma, Tushar Bhardwaj	Springer International Publishing	2023
2	ARTIFICIAL INTELLIGENCE IN CYBER SECURITY	Rahul Neware Khaja Mannanuddin, Mukesh Madanan, Dr. Shikha Gupta	Book Rivers	2022

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Hands-on Artificial Intelligence for Cybersecurity	Alessandro Parisi	Packt Publishing	2022
2	Artificial Intelligence for Cybersecurity: Techniques, Challenges and Research	Mark Stamp	Springer International Publishing	2022
3	Generative AI for Cybersecurity	Edited Volume	Springer	2023

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=fC7V8QsPBec
2	https://www.youtube.com/watch?v=oJlb4jBbKWw
3	https://www.youtube.com/watch?v=oJlb4jBbKWw
4	https://www.youtube.com/watch?v=oJlb4jBbKWw

SEMESTER S6

OT THREAT PREVENTION

Course Code	25CCT634	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Fundamentals and advanced Industrial Cyber Security	Course Type	Theory

Course Objectives:

1. Enables the learners to understand the Distinctions and Integration of OT and IT Systems and helps the students to identify the difference between OT and IT networks in Industrial Systems.
2. Enables the students to identify and classify OT Assets based on criticality.
3. Enables the learners to implement Access Control and Secure Network Access.
4. Enables the learners to monitor, analyze, and respond to Threats and Vulnerabilities

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Understanding OT and IT Systems Overview of OT and IT Systems: Defining Operational Technology (OT) and Information Technology (IT), Key differences between OT and IT in terms of architecture, functionality, and security, Independent OT networks: Architecture, use cases, and benefits. Integration of OT with IT Networks: Drivers for OT-IT convergence, Challenges in integrating OT with IT networks, Common architectures for OT-IT integration Threats and Vulnerabilities in Integrated Networks:Threat landscape for integrated OT-IT environments, Vulnerabilities specific to OT, IT, and their integration, Case studies of security incidents in integrated networks	9

2	Asset Identification and Criticality Classification: Identifying OT Assets: Techniques for asset discovery in OT environments, Importance of maintaining an up-to-date asset inventory, Tools and technologies for OT asset identification Criticality Classification: Criteria for classifying OT assets based on criticality, Impact analysis of OT asset failure on overall operations, Prioritizing security efforts based on asset criticality Risk Management and Compliance: Applying risk management frameworks in integrated networks, Compliance considerations in OT-IT integration, Standards and best practices (e.g., NIST, IEC 62443)	10
3	Securing Access and Dynamic Network Segmentation: Securing Wired and Wireless Access: Best practices for securing wired access in OT-IT networks, Wireless security protocols and their application in OT environments, Managing and securing remote access in integrated networks Dynamic Network Segmentation: Concepts of network segmentation and micro-segmentation, Implementing dynamic network segmentation in OT-IT environments. Monitoring, Analysis, and Threat Response Monitoring and Threat Detection: Importance of continuous monitoring in integrated OT-IT networks, Tools and techniques for monitoring OT and IT systems.	12
4	Analyzing Threats and Vulnerabilities: Techniques for analyzing security data from integrated networks, Vulnerability management and patching in OT-IT systems, Incident detection and analysis for OT-IT integrated environments. Incident Response and Recovery: Developing incident response plans specific to OT-IT integration, Threat hunting and proactive security measures, Recovery strategies and business continuity planning for integrated networks.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Differentiate Between OT and IT Systems and Understand Their Integration.	K2
CO2	Identify, Inventory, and Classify OT Assets Based on Criticality.	K2
CO3	Implement Effective Access Control and Secure Network Access Mechanisms.	K3
CO4	Deploy Continuous Monitoring and Advanced Threat Detection Systems.	K3
CO5	Develop and Execute Comprehensive Incident Response and Recovery Plans.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2		1	1	2				1
CO2	3	2	2	2	1	1	1	2				1
CO3	3	3	2	3	1	2		2	2		1	1
CO4	3	3	3	3	2	3	2	3	2	2	1	2
CO5	3	3	3	3	3	3	2	3	3	3	2	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Practical Industrial Cybersecurity: ICS, OT, and IIoT	Philip A. Craig	Delmar Cengage Learning	Thomson 2nd edition, 2013
2	Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS	Tyson Macaulay, Bryan L. Singer	CRC Press	1 st edition, 2012
3	Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure	Eric D. Knapp, Raj Samani	Syngress	1 st edition, 2013
4	Industrial Network Security :Securing Critical Infrastructure Networks for Smart Grid, SCADA and other Industrial Control Systems	Eric D Knapp Joel Thomas Langill	Syngress	2 nd Edition, 2014
5	Industrial Cybersecurity: Efficiently Secure Critical Infrastructure Systems	Pascal Ackerman	Packt Publishing	2 nd Edition, 2021
6	Building an Effective Cybersecurity Program: Lessons Learned from an Industrial Control Systems Environment	Tari Schreider	Rothstein Publishing	1 st edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Automation using PLC , SCADA & DCS	R.G.Jamkar	Global Education Ltd	2 nd Edition, 2018
2	Handbook of SCADA/Control Systems Security	Robert Radvanovsky, Jacob Brodsky	CRC Press	2 nd Edition, 2016
3	Effective Cyber security : A Guide to Using Best Practices and Standards	William Stallings	Addison-Wesley Professional	1 st edition, 2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106/105/106105217/ https://nptel.ac.in/courses/108/105/108105088/
2	https://nptel.ac.in/courses/108/101/108101167/ https://nptel.ac.in/courses/106/105/106105217/
3	https://nptel.ac.in/courses/106/106/106106220/ https://nptel.ac.in/courses/108/108/108108122/
4	https://nptel.ac.in/courses/108/108/108108098/ https://nptel.ac.in/courses/106/105/106105217/

SEMESTER S6

BIOMETRIC SECURITY

Course Code	25CCT635	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with a comprehensive understanding of the principles, technologies, and processes involved in biometric systems, including various recognition techniques and performance measures.
2. To enable students to critically evaluate security issues, privacy concerns, and biometric standards, while exploring the practical applications of biometric systems across different fields.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Biometric fundamentals – Biometric technologies – Biometrics Vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems, FAR, FRR, FTE rate, EER and ATV rate, Applications of Biometric Systems, Security and Privacy Issues, Physiological Biometrics and Behavioural Biometrics.	8
2	Fingerprint recognition: Friction ridge patterns, Acquisition, Feature extraction, matching, indexing, synthesis, palm print. Face recognition: Introduction, image acquisition, face detection. Feature extraction of face recognition, matching, heterogeneous face recognition. Signature-scan, Keystroke Scan– components, working principles.	11

3	Iris recognition, Image acquisition, iris segmentation, normalization. Encoding and matching, quality assessment, performance evaluation Ear detection and recognition – challenges, gait and hand geometry. Feature extraction and matching	8
4	Security of bio-metric systems: adversary attacks, attacks on user interface, attacks on bio-metric processing, database attacks. Biometric standards, biometric databases	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamental concepts of biometric systems, including their technologies and key processes.	K2
CO2	Understand key performance metrics of biometric systems and their relevance to system accuracy.	K2
CO3	Apply various biometric recognition techniques, including fingerprint, face, iris, and palm print recognition, understanding the acquisition, feature extraction, and matching processes.	K3
CO4	Identify potential security and privacy threats in biometric systems, and recommend strategies to mitigate attacks on biometric processing, user interfaces, and databases.	K3
CO5	Understand the biometric standards, databases, and their applications across different industries, as well as the differences between physiological and behavioural biometrics.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									2
CO2	2	2	2									2
CO3	3	3	2	2	2							2
CO4	3	3	2	2	2							2
CO5	2	2	2	2	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Biometrics	Anil K. Jain, Arun A. Ross, Karthik Nandakumar,	Springer	2011
2	Handbook of Biometrics	Jain, P. Flynn, A. Ross	Springer	2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Biometric Technologies and Verification Systems	John R. Vacca	Elsevier	2007
2	Biometrics – Identity Verification in a Networked World	Samir Nanavati, Michael Thieme, Raj Nanavati	Wiley-dreamtech India Pvt Ltd, New Delhi	2003
3	Biometrics for Network Security	Paul Reid	Pearson Education, New Delhi	2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=GMDggxifxqk&list=PLbMVogVj5nJSCwX0N6MAXPsKGWFRI5Y5m&index=1
2	https://www.youtube.com/watch?v=7aQgQGeZ_qo&list=PLbMVogVj5nJSCwX0N6MAXPsKGWFRI5Y5m&index=5
3	https://www.youtube.com/watch?v=ZEV3th6_olk&list=PLbMVogVj5nJSCwX0N6MAXPsKGWFRI5Y5m&index=8
4	https://www.youtube.com/watch?v=eNPAas0XgVI&list=PLbMVogVj5nJSCwX0N6MAXPsKGWFRI5Y5m&index=15

SEMESTER S6

ETHICAL HACKING & IOT SECURITY

Course Code	25CCZ604	CIE Marks	60
Teaching Hours/Week (L: T:P: R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None/ (Course code)	Course Type	Theory

Course Objectives:

1. To learn ethical hacking and security challenges in computer networking.
2. To protect the network system using firewalls and filters, about the legal, professional and ethical issues.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Elements of Information Security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Role of Security and Penetration Tester, Penetration Testing Methodologies:– OSSTMM, NIST, OWASP, Categories of Penetration Test, Types of Penetration Tests, Vulnerability Assessment. Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering– shoulder surfing, Dumpster Diving, Piggybacking.	11
2	Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – MITM Attacks – ARP Attacks – Denial of Service Attacks - Hijacking Session with MITM Attack -DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing -Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force Attacks – Traditional Brute Force – Attacking SMTP – Attacking SQL	11

	Servers – Testing for Weak Authentication. Routers, Firewall & Honey pots, IDS &IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.	
3	What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack. Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies. IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.	11
4	Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, Differences between IT and OT Security Practices and Systems, Formal Risk Analysis Structures: OCTAVE and FAIR.	11

Course Assessment Method
(CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Ex-1	Internal Ex-2	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 2 marks (8x2 =16 marks)	2 questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 2 sub divisions. - Each question carries 6 marks. (4x6 = 24 marks)	40

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basic concepts of Ethical hacking	K2
CO2	Utilize the tools to conduct competitive intelligence and social engineering.	K3
CO3	Appreciate the security considerations in IoT.	K2
CO4	Outline the fundamentals of IoT and its underlying physical and logical architecture	K2
CO5	Implement IoT applications using the available hardware and software.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	“Hands on ethical hacking and network defense”, Cengage Learning.	Michael T Simpson, Kent Back man, James Corley,		2nd edition, 2010
2	“Ethical Hacking and Penetration Testing Guide”	Rafay Baloch	CRC Press	2014.
3	“Internet of Things: A hands-on approach”	Arshadeep Bahga, Vijay Madiseti,	University Press	2015 (First edition)
4	Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems,	Dr. Ovidiu Vermesan, Dr. Peter Friess	River Publishers	2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	“Certified Ethical Hacker: A Study Guide”, Wiley Publishing, Inc., 2010.	Kimberly Graves,	Wiley Publishing, Inc.	2010
2	“Hacking Exposed 7 :Network Security Secrets & Solutions”	Stuart Mc Clure, Joel Scambray,	McGraw-Hill publishing,	edition 7, 2012
3	"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”	David Hanes, Gonzalo Salgueiro, Patrick rossetete, Robert Barton, Jerome Henry ,	Pearson Education	1st Edition
4	“Internet of Things: Architecture and Design Principles”	Rajkamal	McGraw Hill (India) Private Limited	

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=fNzpcB7ODxQ
2	https://www.youtube.com/@HackerSploit
3	https://www.youtube.com/watch?v=7zWVxrjIpE
4	https://www.youtube.com/playlist?list=PL1ljc761XCiaTRguclgZS8pbTEyt1BjX

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	Practical	Presentation
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation/ Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		30

1. Project Planning and Proposal (5 Marks)

- Clarity and feasibility of the project plan
- Research and background understanding
- Defined objectives and methodology

2. Contribution in Progress Presentation and Question Answer Sessions (4 Marks)

- Individual contribution to the presentation
- Effectiveness in answering questions and handling feedback

3. Involvement in the Project Work and Team Work (3 Marks)

- Active participation and individual contribution
- Teamwork and collaboration

4. Execution and Implementation (10 Marks)

- Adherence to the project timeline and milestones
- Application of theoretical knowledge and problem-solving
- Final Result

5. Final Presentation (5 Marks)

- Quality and clarity of the overall presentation
- Individual contribution to the presentation
- Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)

- Overall quality and technical excellence of the project
- Innovation and originality in the project
- Creativity in solutions and approaches

SEMESTER S6

DESIGN THINKING AND PRODUCT DEVELOPMENT

(Common to Group A & Group B)

Course Code	25EST605	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	60
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To guide students through the iterative stages of design thinking, including empathizing with users, defining problems, ideating solutions and developing Proof of Concepts (PoC) and technical feasibility studies.
2. To promote the development of critical thinking skills by engaging students in integrative inquiry, where they ask meaningful questions that connect classroom knowledge with real-world applications.
3. To equip students with the ability to involve in product design considering the sustainability, inclusivity, diversity and equity aspects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of design thinking and product development: Overview of stages of product development lifecycle; Design thinking -Definition-Design thinking for product innovation; Bringing social impact in ideation- Identifying societal needs-understanding multi-faceted issues-community engagement and empathetic design- technological innovation meeting societal needs; Understanding and Bridging the divide using Human Centered Design (HCD); Designing for inclusivity in product development-	6

	embracing user diversity - Long term impact - sustainability encompassing environmental,economic and social dimensions; Technology Readiness Level in the Innovation Life-cycle; Performing a self-check on innovative ideas - Originality of idea- understanding innovation landscape - patentability - understanding the economic landscape - Unique Selling Proposition (USP) - Repeatability and Manufacturability - Sustainability - Leveraging business models for comprehensive analysis	
2	Empathize: Design thinking phases; Role of empathy in design thinking; Methods of empathize phase - Ask 5 Why/ 5 W+H questions; Empathy maps - Things to be done prior to empathy mapping - Activities during and after the session; Understanding empathy tools - Customer Journey Map - Personas. Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success.	6
3	Ideation : Stages of ideation; Techniques and tools - Divergent thinking tools - Convergent thinking tools - Idea capturing tools; Cross-industry inspiration; Role of research in ideation - Market research - consumer research - leveraging research for informed ideation; Technological trends - navigating the technological landscape - Integrating emerging technologies; Feasibility studies - technical, economic, market, operational, legal, and ethical feasibility; Ideation session- techniques and tips. Proof of Concept (PoC) : Setting objectives; Risk assessment; Technology scouting; Document and process management; Change management; Knowledge Capture; Validating PoC; Story telling in PoC presentation	6
4	Design: Navigating from PoC to detailed design; Developing Specification Requirement Document (SRD)/Software Requirement Specification (SRS); Design for manufacturability; Industrial standards and readability of code; Design to cost; Pre-compliance; Optimized code; Design Failure Mode and Effects Analysis (DFMEA); Forecasting future design changes. Prototyping: Alpha prototypes; Beta prototypes; Transition from design to prototype; Goals and expectations for Alpha and Beta prototypes; Effective strategies for maintaining timeline in prototyping; Testing and refining Alpha prototypes; Transitioning to Beta prototypes. Pilot build: Definition and purpose of a pilot build; setting objectives;	6

	Identification and selection of manufacturing partner for pilot build; Testing procedures in pilot build; Scaling from pilot build to full-scale production / implementation.	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignments	Internal Examination	Reflective Journal and Portfolio	Total
5	20	10	5	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Empathize to capture the user needs and define the objectives with due consideration of various aspects including inclusivity, diversity and equity	K5
CO2	Ideate using divergent and convergent thinking to arrive at innovative ideas keeping in mind the sustainability, inclusivity, diversity and equity aspects.	K6
CO3	Engage in Human Centric Design of innovative products meeting the specifications	K5
CO4	Develop Proof of Concepts (PoC), prototypes & pilot build of products and test their performance with respect to the Specification Requirement Document.	K4
CO5	Reflect on professional and personal growth through the learnings in the course, identifying areas for further development	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2		2	3	3	3	2	2		3
CO2	3	2	3		2	3	3	3	2	2		3
CO3	3	2	3		2	3	3	2	2	2		3
CO4	3	2	2		3	3	3	2	2	2		3
CO5	3					3	3	2	2	2		3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Product Sense: Engineering your ideas into reality	Dr. K R Suresh Nair	NotionPress.com	2024
2	Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation	Tim Brown	HarperCollins Publishers Ltd.	2009
3	Design Thinking for Strategic Innovation	Idris Mootee	John Wiley & Sons Inc.	2013

Sample Assignments:

1. Evaluate and prepare a report on how the aspects including inclusivity, diversity and equity are taken into consideration during the empathize and define phases of the Miniproject course.
2. Evaluate and prepare a report on how the aspects including sustainability, inclusivity, diversity and equity are taken into consideration during the ideate phase of the Miniproject course.
3. Evaluate and prepare a report on how User-Centric Design (UCD) is used in the design and development of PoC of the product being developed in the Miniproject course.
4. Prepare a plan for the prototype building of the product being developed in the Miniproject course.
5. Report on the activities during the empathize phase including the maps & other materials created during the sessions.
6. Report on the activities during the define phase including the maps & other materials created during the sessions.
7. Report of all the ideas created during the ideation phase of the Miniproject course through the tools including SCAMPER technique, SWOT analysis, Decision matrix analysis, six thinking hats exercise
8. Prepare a full scale production plan for the product being developed in the Miniproject course.
9. Create a Stanford Business Model Canvas related to the Miniproject.

An industrial visit of at least a day for experiential learning and submit a report on the learnings, for example industry standards and procedures.

SEMESTER 6
DATA STRUCTURES

Course Code	25CST611	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	-	Course Type	Theory

Course Objectives:

1. To provide the learner a comprehensive understanding of data structures and algorithms.
2. To prepare them for advanced studies or professional work in computer science and related fields.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic Concepts of Data Structures Definitions; Data Abstraction; Performance Analysis - Time & Space Complexity, Asymptotic Notations; Polynomial representation using Arrays, Sparse matrix (<i>Tuple representation</i>); Stacks and Queues - Stacks, Multi-Stacks, Queues, Circular Queues;	9
2	Linked List and Memory Management Singly Linked List - Operations on Linked List, Stacks and Queues using Linked List, Polynomial representation using Linked List; Doubly Linked List.	9
3	Trees and Graphs Trees :- Representation Of Trees; Binary Trees - Types and Properties, Binary Tree Representation, Tree Operations, Tree Traversals; Binary Search	9

	Trees - Binary Search Tree Operations; Graphs :- Definitions; Representation of Graphs; Depth First Search and Breadth First Search.	
4	Sorting and Searching Sorting Techniques :- Selection Sort, Insertion Sort, Quick Sort, Merge Sort; Searching Techniques - Linear Search, Binary Search, Hashing - Hashing functions : Division; Collision Resolution : Linear probing, Open hashing.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify appropriate data structures for solving real world problems.	K3
CO2	Describe and implement linear data structures such as arrays, linked lists, stacks, and queues.	K3
CO3	Describe and Implement non linear data structures such as trees and graphs.	K3
CO4	Select appropriate searching and sorting algorithms to be used in specific circumstances.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Data Structures in C	Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed,	Universities Press	2/e, 2007
2	Introduction to Algorithms	Thomas H Cormen, Charles Leisesrson, Ronald L Rivest, Clifford Stein	PHI	3/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Classic Data Structures	Samanta D.	Prentice Hall India.	2/e, 2018
2	Data Structures and Algorithms	Aho A. V., J. E. Hopcroft and J. D. Ullman	Pearson Publication.	1/e, 2003
3	Introduction to Data Structures with Applications	Tremblay J. P. and P. G. Sorenson	Tata McGraw Hill.	2/e, 2017
4	Theory and Problems of Data Structures	Lipschuts S.	Schaum's Series	2/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106102064
2	https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/

SEMESTER S6

DATA COMMUNICATION

(Common to CS/CM/CD/CA)

Course Code	25CST612	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the details of data communication at the lower level and the associated issues.
2. To gain insight into the important aspects of data communication and computer networking systems and to apply the in practical applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Communication model - Simplex, Half duplex, Full duplex transmission. Periodic analog signals - Sine wave, Amplitude, Phase, Wavelength, Time and frequency domain, Bandwidth. Analog & digital data and signals. Transmission impairments - Attenuation, Delay distortion, Noise. Data rate limits - Noiseless channel, Nyquist bandwidth, Noisy channel, Shannon's capacity formula. Guided transmission media - Twisted pair, Coaxial cable, Optical fiber. Unguided media - Radio waves, Terrestrial microwave, Satellite microwave, Infrared. Wireless propagation - Ground wave propagation, Sky wave propagation, Line-of-Sight (LoS) propagation.	10
2	Digital data to digital signal – Non-Return-to-Zero (NRZ), Return-to-Zero (RZ), Multilevel binary, Biphasic. Analog data to digital signal - Sampling theorem, Pulse Code Modulation (PCM), Delta Modulation (DM). Digital	9

	data to analog signal - Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK). Analog data to analog signal - Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM).	
3	Multiplexing - Frequency Division Multiplexing (FDM), Wavelength Division Multiplexing (WDM), Time Division Multiplexing (TDM), Characteristics, Synchronous TDM, Statistical TDM. Spread spectrum techniques - Direct Sequence Spread Spectrum (DSSS), Frequency Hopping Spread Spectrum (FHSS), Code Division Multiplexing, Code Division Multiple Access (CDMA).	8
4	Digital data communication techniques - Asynchronous transmission, Synchronous transmission. Detecting and correcting errors - Types of errors, Parity check, Checksum, Cyclic Redundancy Check (CRC), Forward Error Correction (FEC), Hamming distance, Hamming code. Basic principles of switching - Circuit switching, Packet switching, Message switching.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the characteristics of signals for analog and digital transmissions so as to define the associated real world challenges.	K3
CO2	Select transmission media based on characteristics and propagation modes.	K3
CO3	Choose appropriate signal encoding techniques for a given scenario	K3
CO4	Illustrate multiplexing and spread spectrum technologies	K2
CO5	Use error detection, correction and switching techniques in data communication	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	2								3
CO3	3	3		2								3
CO4	3	3	3	2								3
CO5	3	3	3	2								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data Communications and Networking	Forouzan B. A	McGraw Hill	6/e, 2019
2	Data and Computer Communication	William Stallings	Pearson	10/e, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mobile Communications	Schiller J	Pearson	2/e, 2009
2	Fundamentals of Networking and Communication	Curt M. White	Cengage	7/e, 2010

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106105082

SEMESTER S6

FOUNDATIONS OF CRYPTOGRAPHY

Course Code	25CST613	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. Develop a foundational understanding of mathematical concepts in cryptography,
2. Gain comprehensive knowledge of cryptographic methods.
3. Understand the principles and need for computer security.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Integer Arithmetic – Divisibility, Greatest Common Divisor Euclid's and Extended Euclid's Algorithm for GCD; Modular Arithmetic – Operations, Properties, Polynomial Arithmetic; Algebraic Structures – Group Ring Field.	9
2	Prime numbers and Prime Factorisation - Primitive Roots, Existence of Primitive Roots for Primes, Fermat's Theorem, Primality Testing, Euler's Theorem, Euler's Totient Function, Discrete Logarithms, Modular Arithmetic, Chinese Remainder Theorem.	9
3	Principles of security - Types of Security attacks, Security services, Security Mechanisms; Cryptography - Introduction, cryptographic notations, substitution techniques, Transposition Techniques, limitations of classical cryptography.	9
4	Symmetric key Ciphers - Block Cipher principles & Algorithms- DES, AES, Differential and Linear Cryptanalysis; Asymmetric Key Ciphers- RSA, ECC; Hash Functions - MD5, SHA-1.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the integer arithmetic operations including divisibility and GCD algorithms, modular arithmetic operations and properties, polynomial arithmetic, and algebraic structures such as groups, rings, and fields.	K2
CO2	Describe the number theory concepts essential for cryptographic applications and mathematical problem-solving.	K2
CO3	Explain the security principles, types of attacks, and protective measures, alongside a thorough understanding of cryptographic techniques and their applications in securing data.	K2
CO4	Discuss symmetric and asymmetric key cryptography, including block cipher principles, algorithms, public key cryptosystems, and hash functions	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	2	2										2
CO3	2	2										2
CO4	2	2										2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography & Network Security	Behrouz A. Forouzan	McGraw Hill	3/e, 2007
2	Security in Computing	Charles P. Pfleeger, Shari L. Pfleeger, Jonathan Margulies	Prentice Hall	5/e, 2015
3	Introduction to Cryptography: Principles and Applications	H. Delfs, H. Knebl	Springer	1/e, 2002
4	A Classical Introduction to Cryptography: Applications for Communications Security	Serge Vaudenay	Springer	1/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cryptography and Network Security	William Stallings	Pearson Education	7/e, 2017

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/111/101/111101137/
2	https://nptel/courses/video/106105031/L17.html
3	https://onlinecourses.nptel.ac.in/noc22_cs90/preview

SEMESTER S6

MACHINE LEARNING FOR ENGINEERS

(Common to CS/CA/CD/CM/CR/AD/AM/AI)

Course Code	25CST614	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide the basic concepts and algorithms in machine learning.
2. To discuss the standard and most popular supervised and unsupervised learning algorithms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to ML Machine Learning vs. Traditional Programming, Machine learning paradigms - supervised, semi-supervised, unsupervised, reinforcement learning. Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum a posteriori estimation (MAP), Bayesian formulation. Supervised Learning Feature Representation and Problem Formulation, Role of loss functions and optimization Regression - Linear regression with one variable, Linear regression with multiple variables - solution using gradient descent algorithm and matrix method.	10

2	Classification - Naïve Bayes, KNN Generalisation and Overfitting - Idea of overfitting, LASSO and RIDGE regularization, Idea of Training, Testing, Validation Evaluation measures – Classification - Precision, Recall, Accuracy, F-Measure, Receiver Operating Characteristic Curve(ROC), Area Under Curve (AUC). Regression - Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R Squared/Coefficient of Determination.	8
3	Neural Networks (NN) - Perceptron, Neural Network - Multilayer feed-forward network, Activation functions (Sigmoid, ReLU, Tanh), Back propagation algorithm. Decision Trees – Information Gain, Gain Ratio, ID3 algorithm	8
4	Unsupervised Learning Clustering - Similarity measures, Hierarchical Clustering - Agglomerative Clustering, partitional clustering, K-means clustering Dimensionality reduction - Principal Component Analysis, Multidimensional scaling Ensemble methods - bagging, boosting Resampling methods - Bootstrapping, Cross Validation. Practical aspects - Bias-Variance trade-off	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate Machine Learning concepts and basic parameter estimation methods	K2
CO2	Demonstrate supervised learning concepts (regression, classification)	K3
CO3	Illustrate the concepts of Multilayer neural network and Decision trees	K3
CO4	Describe unsupervised learning concepts and dimensionality reduction techniques	K3
CO5	Use appropriate performance measures to evaluate machine learning models	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								2
CO2	3	3	3	3	2							2
CO3	3	3	3	3	2							2
CO4	3	3	3	3	2							2
CO5	3	3	3	3	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	2/e, 2010
5	Data Mining and Analysis: Fundamental Concepts and Algorithms	Mohammed J. Zaki, Wagner Meira	Cambridge University Press	1/e, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Machine Learning	Tom Mitchell	McGraw-Hill	1997
2	Applied Machine Learning	M Gopal	Pearson	2/e, 2018
3	Neural Networks for Pattern Recognition	Christopher Bishop	Oxford University Press	1995
4	Machine Learning: A Probabilistic Perspective	Kevin P Murphy	MIT Press	1/e, 2012
5	The Elements Of Statistical Learning	Trevor Hastie, Robert Tibshirani, Jerome Friedman	Springer	2/e, 2007

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/fC7V8QsPBec?si=8kqBn-_7x1RG5V1J
2	https://youtu.be/g__LURKuIj4?si=Xj10NPfMfpQSOhVx
3	https://youtu.be/yG1nETGyW2E?si=ySlxpeWuFAUQBf7-
4	https://youtu.be/zop2zuwF_bc?si=W7TpSHLdi4rykva4

SEMESTER S6

OBJECT ORIENTED PROGRAMMING

(Common to CS/CA/CD/CM/AM/AD)

Course Code	25CST615	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To teach the core object-oriented principles such as abstraction, encapsulation, inheritance, and polymorphism, robust error-handling using exception mechanisms to ensure program reliability.
2. To equip the learner to develop object oriented programs encompassing fundamental structures, environments, and the effective utilization of data types, arrays, strings, operators, and control statements for program flow in Java.
3. To enable the learner to design and develop event-driven graphical user interface (GUI) database applications using Swing and database connection components.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Java - Java programming Environment and Runtime Environment (Command Line & IDE); Java compiler; Java Virtual Machine; Primitive Data types and Wrapper Types; Casting and Autoboxing; Arrays; Strings; Vector class; Operators - Arithmetic, Bitwise, Relational, Boolean Logical, Assignment, Conditional (Ternary); Operator Precedence; Control Statements - Selection Statements, Iteration Statements and Jump Statements; Functions; Command Line Arguments; Variable Length Arguments; Classes; Abstract Classes; Interfaces; OOP Concepts - Data	10

	abstraction, encapsulation, inheritance, polymorphism, Procedural and object oriented programming paradigm; Microservices; Object Oriented Programming in Java - Declaring Objects; Object Reference; Introduction to Methods; Constructors; Access Modifiers; this keyword.	
2	Polymorphism - Method Overloading, Using Objects as Parameters, Returning Objects, Recursion; Static Members, Final Variables, Inner Classes. Inheritance - Super Class, Sub Class, Types of Inheritance, The super keyword, protected Members, Calling Order of Constructors; Method Overriding, Dynamic Method Dispatch, Using final with Inheritance.	8
3	Packages and Interfaces – Packages - Defining a Package, CLASSPATH, Access Protection, Importing Packages; Interfaces - Interfaces v/s Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface(s); Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw , throws and finally , Java Built-in Exceptions, Custom Exceptions.	9
4	Swings fundamentals – Overview of AWT, Swing v/s AWT, Swing Key Features, Swing Controls, Components and Containers, Swing Packages, Event Handling in Swings, Swing Layout Managers, Exploring Swings– JFrame, JLabel, The Swing Buttons, JTextField; Event handling – Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model; Developing Database Applications using JDBC – JDBC overview, Types, Steps, Common JDBC Components, Connection Establishment.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the process of developing Java programs, including their structure and components, to demonstrate proficiency.	K2
CO2	Utilize object-oriented programming principles in the design and implementation of Java applications.	K3
CO3	Develop and manage Java packages and interfaces, enhancing code modularity and reusability.	K3
CO4	Implement error handling using Java's exception mechanisms and leverage interfaces for modular applications.	K3
CO5	Develop event-driven Java GUI applications with database connectivity.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										3
CO2	3	3	3									3
CO3	3	3	3		3							3
CO4	3	3	3		3							3
CO5	3	3	3		3							3

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Java: The Complete Reference	Herbert Schildt	Tata McGraw Hill	13/e, 2024
2	Introduction to Java Programming, Comprehensive Version	Y Daniel Liang	Pearson	10/e, 2014
3	Head First Design Patterns	Eric Freeman, Elisabeth Robson, Bert Bates, Kathy Sierra	O'Reilly Media	1/e, 2004

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Head First Java: A Brain Friendly Guide	Kathy Sierra & Bert Bates	O'Reilly	3/e, 2022
2	JAVA™ for Programmers	Paul Deitel	PHI	11/e, 2018
3	Clean Code : A Handbook of Agile Software Craftsmanship	Robert C. Martin	Prentice Hall	1/e, 2008
4	Programming with Java	E Balagurusamy	McGraw Hill	6/e, 2019
5	Java For Dummies	Barry A. Burd	Wiley	8/e, 2022
6	Effective Java	Joshua Bloch	Pearson	3/e, 2018

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106105191 (Lecture no: 9, 10, 1, 2, 3, 4)
2	https://nptel.ac.in/courses/106105191 (Lecture no: 1, 7, 8, 11, 12, 13, 14, 15, 16)
3	https://nptel.ac.in/courses/106105191 (Lecture no: 17, 18, 19, 20, 21, 22, 23, 24, 25, 26)
4	https://nptel.ac.in/courses/106105191 (Lecture no: 43, 44, 45, 46, 47, 50, 51, 52, 53, 54, 55)

SEMESTER S6

CYBER FORENSICS LAB

Course Code	25CCL607	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25CCT602	Course Type	Lab

Course Objectives:

1. The course aims to master Cyber Forensics procedures and get hands-on exposure to different Cyber Forensics tools.
2. The course aims to offer hands-on experience on integrity check of files and use it for security implementations.
3. The course aims to offer exposure to live and static forensic analysis.

Expt. No.	Experiments
1	Registry Viewing and Editing using native tools of Operating Systems.
2	Hex analysis using Hex Workshop tool Using Hex Workshop perform file signature analysis. Write down the hex values of popular file types
3	Bit level Forensic Analysis of evidential image using FTK or Encase or ProDiscover Tools. Image Acquisition and perform static analysis to mount an image of a drive.
4	Hash code generation, comparison of files using tools like HashCalc Using HashCalc write down the Hash values of popular hashing algorithms.
5	Command line Analysis of disk images using The SleuthKit(TSK) tool
6	File System Forensic Analysis using Autopsy tool. Using Autopsy perform file signature analysis. Write down the investigation report.

7	Network Protocol Analysis using Wireshark and nmap.
8	Live Forensics and Memory Dump Analysis using LiME and Volatility Framework
9	Network Log analysis

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- **Submission of Record:** Students shall be allowed for the end semester examination only upon submitting the duly certified record.
- **Endorsement by External Examiner:** The external examiner shall endorse the record

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use the Windows Registry and Registry Editor.	K3
CO2	Use the different Cyber Forensics Tools for static and dynamic forensics analysis.	K3
CO3	Familiarize file signature analysis and applications.	K3
CO4	Use FTK or Encase or ProDiscover tools for bit level forensic analysis of evidential image.	K3
CO5	Prepare an investigation report following the chain of custody.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO- PO Mapping (Mapping of Course Outcomes with Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	3										
CO3	3	3										
CO4	3	3										
CO5	3	3			3							

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Guide to computer forensics and investigations	Bill Nelson, Amelia Philipps and Christopher Steuart	Cengage	6 th Edition 2020
2	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress	2 nd Edition, 2009
3	Unix and Linux Forensic Analysis DVD Toolkit	Chris Pogue , Cory Altheide, Tode Haverkos	Syngress	1 st Edition, 2008

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

- Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
- Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

- Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
- Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
- Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

- Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
- Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

- Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work/Design/Algorithm (10 Marks)

- Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.
- Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.
- Algorithm Development: Correctness and efficiency of the algorithm related to the experiment.
- Creativity and logic in algorithm or experimental design.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

- Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

- Accuracy of Results: Precision and correctness of the obtained results.
- Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. Viva Voce (10 Marks)

- Ability to explain the experiment, procedure results and answer related questions
- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

- Completeness, clarity, and accuracy of the lab record submitted

SEMESTER

S6 MINI PROJECT

Course Code	25CCP608	CIE Marks	75
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	75
Credits	2	Exam Hours	
Prerequisites (if any)		Course Type	Project

Preamble: The objective of this course is to apply the fundamental concepts of Software Engineering principles for the effective development of an application/research project. This course helps the learners to practice the different steps to be followed in the software development process such as literature review and problem identification, preparation of Software Requirement Specification & Software Design Document (SDD), testing, development and deployment. Mini project enables the students to boost their skills, widen the horizon of thinking and their ability to resolve real life problems.

Prerequisite: A sound knowledge in any programming language and fundamental concepts of Software Engineering.

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

CO#	CO
CO1	Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)
CO2	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)
CO4	Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)
CO5	Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

C03												
C04												
C05												

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	1 Hour

Split-up of CIE

Component	Marks
Attendance	5
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	20

Split-up of ESE

Component	Marks
Demonstration of functionality	20
Project Report	5
Viva-voce	15
Presentation	10

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department comprising HoD or a senior faculty member, Mini Project coordinator and project guide. The internal evaluation shall be made based on the progress/outcome of the project, reports and a viva-voce examination, conducted internally by a 3-member committee. A project report is required at the end of the semester. The project has to be demonstrated for its full design specifications.

TEACHING PLAN

Students are expected to follow the following steps.

1. Review of Literature and Identification of a problem
2. Create an abstract with a problem statement, solution approach, technology stack, team, etc. and get department approval. Register Online course/ Collect study materials.
3. Create Software Requirements Specification (SRS Document)
4. Create Software Design Document (SDD). This may include designs like,
 - a. System Architecture Design
 - b. Application Architecture Design
 - c. GUI Design (Mockups)
 - d. API Design
 - e. Database Design
 - f. Technology Stack
5. Create Test Plan, Test Scenarios and Test Cases (Test Case Document) & Traceability Matrix
6. Create a Project Plan (with Modules, Tasks, Resources, Time schedule) [May use any project management tool or excel for this] – Choose and follow agile or waterfall models.
7. Development
 - a. Set coding standards
 - b. Environment Setup
 - c. Source Code Control Setup (Like Subversion(SVN), Git)
 - d. Development
 - e. Unit Testing
 - f. Integration Testing
 - g. Testing /Quality Assurance(QA)
 - i. Functional Testing
 - ii. Load Testing
 - iii. Report Bugs
 - h. Resolve Bugs & Retest

8. Deployment (of software from local development environment to a production environment)
9. Test Run & Get Results
10. Prepare Project Report

Guidelines for the Report preparation

A bonafide report on the mini project shall be submitted within one week after the final presentation. Minimum number of pages should be 40.

- Use Times New Roman font for the entire report – Chapter/Section Title – Times New Roman 18, Bold; Heading 2 – Times New Roman 16, Bold; Heading 3 – Times New Roman 14, Bold; Body- Times New Roman 12, Normal.
- Line Spacing – Between Heading 2 – 3 lines, between lines in paragraph 1.5 lines.
- Alignments – Chapter/Section Title – Center, Heading 2 & 3 should be Left Aligned. Ensure that all body text is paragraph justified.
- Figures & Tables – Ensure that all Figures and Tables are suitably numbered and given proper names/headings. Write figure title under the figure and table title above the table.
- **Suggestive order of documentation:**
 - i. Top Cover
 - ii. Title page
 - iii. Certification page
 - iv. Acknowledgement
 - v. Abstract
 - vi. Table of Contents
 - vii. List of Figures and Tables
 - viii. Chapters
 - ix. Appendices, if any
 - x. References/Bibliography

SEMESTER S7

**Computer Science and Engineering
Cyber Security**

SEMESTER S7
MALWARE FORENSICS

Course Code	25CCT741	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	PECCT602	Course Type	Theory

Course Objectives:

1. Acquire the ability to identify and assess various forms of malware, enabling students to tackle the difficulties presented by newly evolving malware.
2. Applying both automatic and manual methods to examine malware, comprehend malware activity monitoring tools and various malware analysis techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to malware, malware threats, evolution of malware, malware types. Types of malware Analysis – Static Analysis, Dynamic Analysis, Malware Analysis Techniques - Obfuscated, Deobfuscated, Malware Analysis Tools - Static Analysis Tools, Dynamic Analysis Tools. Static Analysis	8
2	Dynamic analysis: Live malware analysis, dead malware analysis, analyzing traces of malware, system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode, Debugging-OllyDbg, Breakpoints, Tracing, Exception Handling, Patching. Malware Detection Techniques: Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic signature. Non-signature based techniques: similarity-based techniques, machine-learning methods.	11
3	Malware Incident response: Volatile Data Collection and Examination on a Live Windows Systems - Volatile Data collection methodology from	10

	Windows systems- Preservation of Volatile data, Collecting Subject System details, Identifying users Logged into the System, Inspect Network Connections and Activity, Current and Recent Network Connections, Collecting Process Information, Correlate Open Ports with Running Processes and Programs, Identifying Services and Drivers, Determining Scheduled Tasks, Collecting Clipboard Contents, Non-Volatile Data Collection from a Live Windows System, Volatile Data collection methodology from Linux systems, Non volatile Data collection from a live Linux system	
4	Post-Mortem Forensics - Malware Discovery and Extraction from a Windows and Linux system, Examine Windows and Linux file system, Examine application traces, Examine Windows registry, keyword searching from Windows and Linux systems, Forensic reconstruction of compromised Linux and Windows system.	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the evolution, types, and threats of malware, and enable the identification and classification of malicious software.	Understand
CO2	Understand static and dynamic analysis techniques to investigate malware, utilizing tools to assess and mitigate malware impacts on systems.	Understand
CO3	Understand anti-dynamic analysis techniques to enhance the effectiveness of malware analysis and detection.	Understand
CO4	Analyse and employ both signature-based and non-signature-based malware detection techniques to detect and prevent advanced malware threats.	Analyse
CO5	Understand malware incident response strategies and post-mortem forensics on compromised Windows and Linux systems, to ensure comprehensive system recovery and threat mitigation.	Understand

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3		2							3
CO3	3	3	3		2							3
CO4	3	3	3		2							3
CO5	3	3	3	3	2							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Malware Forensics Field Guide for Windows Systems: Digital Forensics Field Guides	James M. Aquilina, Cameron H. Malin, Eoghan Casey	Syngress Publishing	First Edition, 2012
2	Malware Forensics Field Guide for Linux Systems: Digital Forensics Field Guides” ,	James M. Aquilina, Cameron H. Malin, Eoghan Casey	Syngress Publishing	Second Edition, 2014
3	Practical malware analysis The Hands-On Guide to Dissecting Malicious Software	Michael Sikorski and Andrew Honig	No starch press	First Edition, 2012
4	Malware Forensics Investigating and Analysing Malicious code	Eoghan Casey, James M. Aquilina, Cameron H. Malin,	Syngress Publishing,	First Edition, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Malware & rootkits: malware & rootkits security secrets & Solutions	Michael Davis, Sean Bodmer, Aaron Lemasters	McGraw Hill	Second Edition, 2010
2	Windows Malware Analysis Essentials	Victor Marak	Packt Publishing	First Edition, 2015

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=Bvqyg51Czdk
2	https://www.youtube.com/watch?v=uHhKkLwT4Mk&list=PLBf0hzazHTGMSIOI2HZGc08ePwut6A2Io&index=1
3	https://www.youtube.com/watch?v=lwUve1VdFYs&list=PLt9cUwGw6CYEpBwasTz7WwghfRWof0_O
4	https://www.youtube.com/watch?v=D0VLE1RnPmE

SEMESTER S7**INTRUSION DETECTION & PREVENTION SYSTEM**

Course Code	25CCT742	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand of the fundamental concepts of Intrusion detection and prevention systems and the different control strategies used to implement IDPS.
2. To understand of the usage of different Intrusion detection systems so that protection against attacks can be minimized.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction-Intrusion Detection and Prevention Systems, IDPS terminology, Network attacks- Probes, Privilege Escalation Attacks, Denial of Service (DoS) and Distributed Denial of Service (DDoS) Attacks, Worms Attacks, Routing Attacks, Why use an IDPS, Types of IDPS, IDPS Detection methods- Signature-Based IDPS, Statistical Anomaly-Based IDPS, Stateful Protocol Analysis IDPS, Log File Monitors, IDPS Response Options Selecting IDPS Approaches and Products, Strengths and Limitations of IDPSs.	9
2	IDPS Control Strategies-Centralized Control Strategy, Fully Distributed Control Strategy, Partially Distributed Control Strategy, IDPS Deployment-Deploying Network-Based IDPSs, Deploying Host Based IDPSs, Measuring the Effectiveness of IDPSs, Intrusion Detection systems-How the IDS Watches Your Network -Packet Sniffing, Log Parsing, System Call Monitoring, Filesystem Watching, What the IDS Does When It Finds an Attack Attempt, Passive Response, Active Response, Analyzing Your IDS Design and Investment, False Positives versus False Negatives.	9

3	IDPS Technologies-components and architecture, Network architectures, security capabilities, prevention capabilities, Network based IDPS, Networking overview, components and architecture, Security Capabilities, Information Gathering Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Detection Accuracy , Tuning and Customization, Technology Limitations, Prevention Capabilities, Implementation, Wireless IDPS, WLAN Standards, WLAN Components, Threats against WLANs, Components and Architecture, Sensor Locations, Information Gathering Capabilities, Types of Events Detected, Prevention Capabilities.	9
4	Host-Based IDPS-Components and Architecture, Typical Components, Network Architectures, Agent Locations, Host Architectures, Security Capabilities, Logging Capabilities, Detection Capabilities, Types of Events Detected, Technology Limitations, Prevention Capabilities, Other Capabilities, Implementation, The Need for Multiple IDPS Technologies, Direct IDPS Integration, Indirect IDPS Integration, Network Forensic Analysis Tool (NFAT) Software, Anti-Malware Technologies, Firewalls and Routers, Honeypots. IDPS Detection Approaches-Misuse detection-pattern matching, Rule based techniques,state based techniques, Anomaly Detection-Advanced Statistical Models, Rule based Techniques, Biological Models, Learning Models, Specification-based Detection, Hybrid Detection, Architecture and Implementation-Centralized, Distributed-Intelligent Agents,Mobile Agents, Cooperative Intrusion Detection	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Comprehend the different terminologies and types related to Intrusion detection and prevention systems.	Understand
CO2	Familiarize the different control strategies and and detection systems.	Understand
CO3	Explore the different technologies and detection capabilities related to Network IDPS.	Understand
CO4	Identify the capabilities, security attacks against wireless IDPS.	Apply
CO5	Explore the different technologies and detection capabilities and approaches related to host IDPS.	Apply

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									2
CO2	3	2	2									2
CO3	3	2	2									2
CO4	3	2	2		2							2
CO5	3	2	2		2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Information Security	Michael E. Whitman and Herbert J. Mattord	Course Technology, Cengage Learning	Fourth Edition ,2012
2	Snort 2.1: Intrusion Detection	Brian Caswell, Mike Poor	Jay Beale's Open Source Security	second edition, 2004.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Guide to Intrusion Detection and Prevention Systems (IDPS)	Karen Scarfone Peter Mell	National Institute of Standards and Technology,	First edition, 2007
2	Network Intrusion Detection	Stephen Northcutt, Judy Novak	New Riders Publications	Third Edition,2002

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=jbQBve0AXzM&pp=ygUQSURQUyB0ZXJtaW5vbG9neQ%3D%3D
2	https://www.youtube.com/watch?v=1EPu-G09xyI&pp=ygUQIEIEUFMgRGVwbG95bWVudA%3D%3D
3	https://www.youtube.com/watch?v=uDlqCaBnpq0&pp=ygUNV2lyZWxlc3MgSURQUw%3D%3D
4	https://www.youtube.com/watch?v=463zDAhN6KE&pp=ygUZSURQUyBEZXRIY3Rpb24gQXBwcm9hY2hlcw%3D%3D

SEMESTER S7**BIG DATA SECURITY**

Course Code	25CCT743	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic Understanding of big Data	Course Type	Theory

Course Objectives:

1. To provide an understanding of the security challenges associated with Big Data systems.
2. To impart knowledge on securing Big Data environments using various techniques and frameworks.
3. To explore privacy-preserving mechanisms and compliance with legal regulations in Big Data.
4. To equip students with skills to identify and mitigate threats and vulnerabilities in Big Data.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Big Data: Definition and characteristics: Volume, Velocity, Variety, Veracity, and Value, Importance of Big Data in modern industries, Security Challenges in Big Data:- Data breaches, privacy concerns, and compliance issues ,The CIA triad in the context of Big Data. Big Data Architecture: Hadoop ecosystem: HDFS, Map Reduce, YARN, Apache Spark: Resilient Distributed Datasets (RDDs) and Data Frames, NoSQL databases: Cassandra, MongoDB. Case Studies: Real-world examples of Big Data security breaches and their implications.	8
2	Security Mechanisms: Authentication and Authorization: Kerberos, LDAP, Access Control Frameworks: Apache Ranger, Apache Sentry, Data Encryption: AES, RSA, SSL/TLS for data in transit and at rest.	8

	Data Privacy Issues -Overview of data privacy in Big Data: PII, sensitive data, and business data. Anonymization Techniques: - Techniques like k-anonymity, l-diversity, t-closeness, Differential Privacy: -Concept, mechanisms, and applications.	
3	Legal and Compliance Frameworks:- Overview of GDPR, CCPA, HIPAA, and their implications for Big Data, Threat Landscape: - Common threats: Insider threats, APTs, ransomware, and DDoS attacks in Big Data. Vulnerabilities: - Vulnerabilities in distributed frameworks: Hadoop, Spark, and NoSQL databases, Security flaws in data aggregation and integration processes. Case studies on compliance challenges and solutions.	10
4	Risk Management - Risk assessment frameworks and tools specific to Big Data, Threat modelling: STRIDE, DREAD models for Big Data systems. Security Best Practices: - Data masking, tokenization, and maintaining audit trails, Secure coding practices for Big Data applications. Security Monitoring and Incident Response:- Security Information and Event Management (SIEM) for Big Data, Incident response strategies for Big Data breaches	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and articulate the key characteristics of Big Data and the security challenges, including the CIA triad, within Big Data architectures like Hadoop and Apache Spark.	K2
CO2	Understand security mechanisms such as authentication, authorization, encryption, and anonymization techniques to protect sensitive data within Big Data environments	K2
CO3	Understand the implications of major legal frameworks (e.g., GDPR, CCPA, HIPAA) on Big Data, identifying common threats and vulnerabilities in distributed systems.	K2
CO4	Develop and implement risk management strategies, including threat modelling and security best practices, to safeguard Big Data systems and respond effectively to security incidents	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1							1	
CO2	3	2	3	2							2	
CO3	3	2	2	3							2	
CO4	3	3	3	3							2	

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Big Data: Principles and Best Practices of Scalable Real-time Data Systems	Nathan Marz and James Warren.	Manning Publications	1 st edition 2015
2	Hadoop Security: Protecting Your Big Data Platform	Ben Spivey and Joey Echeverria	O'Reilly Media	1 st edition 2015
3	Big Data Security	Hemalatha M, B. K. Tripathy, and L. Sudha.	CRC	1 st edition 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Security and Privacy in Big Data: Volume 1: Foundations	Shui Yu and Xiaodong Lin.	Springer	1 st edition
2	Data-Intensive Text Processing with MapReduce	Jimmy Lin and Chris Dyer	Morgan & Claypool	1 st edition
3	Privacy-Preserving Data Publishing: Anonymization Models, Algorithms, and Applications	Benjamin C. M. Fung, Ke Wang, Ada Wai-Chee Fu, and Philip S. Yu.	Chapman and Hall	1 st edition
4	Computer Security: Principles and Practice	William Stallings and Lawrie Brown	Pearson	4 th edition

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	[Introduction to Big Data (NPTEL)] [Big Data Computing)
2	Cloud Computing (NPTEL)
3	- [Information Security - V (NPTEL)]
4	[Information Security - IV (NPTEL)] - [Network Security [NPTEL]]

SEMESTER S7**SECURITY OPERATIONS ANALYSIS**

Course Code	25CCT746	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Industrial Cyber Security , OT Threat Prevention	Course Type	Theory

Course Objectives:

1. Enables the learners to Understand the Role of SOC in Industrial Environments.
2. Enables the students to Integrate IT and OT Security Practices.
3. Enables the learners to Leverage Industrial-Specific Threat Intelligence.
4. Enables the learners to Execute Incident Response and Forensics in OT.
5. Enables the learners to Apply Advanced Security Operations Techniques in OT.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	SOC in Industrial Environments Overview of SOC Operations in OT Environments: Role of SOC in industrial settings, Challenges of monitoring OT networks vs. IT networks Integration of IT and OT Security Monitoring: Convergence of IT and OT systems, Tools and techniques for unified monitoring. Incident Detection in OT Networks: Threat vectors and vulnerabilities in OT environments, Detection techniques for SCADA, PLCs, and ICS	9
2	Threat Intelligence for Industrial Cyber Security Industrial-Specific Threat Intelligence: OT-specific threat intelligence sources, ISACs and proprietary feeds for industrial environments Vulnerability Management in OT: Identifying and managing OT system vulnerabilities, Challenges in patch management for critical systems Integrating Threat Intelligence with OT Systems: Correlating threat intelligence with industrial protocols, Case studies of OT-targeted attacks	10

3	Incident Response and Forensics in Industrial Environments Incident Response Strategies for OT: Responding to incidents in OT environments, Balancing operational safety with security response. Forensic Analysis of OT Incidents: Techniques for forensic analysis in OT systems, Data acquisition and analysis from industrial devices. Coordination with Industrial Stakeholders: Collaborating with engineering and operations teams, Best practices for communication during OT incidents.	11
4	Advanced Security Operations and Continuous Improvement in OT Advanced Threat Detection in OT: Anomaly detection for industrial protocols, Machine learning for OT-specific threat detection. Proactive Security Measures in OT: Threat hunting in OT networks, Red and purple teaming in industrial settings. Security Metrics and Reporting in OT: KPIs for OT security operations, Reporting to technical and non-technical stakeholders. Continuous Improvement in OT Security Operations: Post-incident reviews and OT security audits, Feedback loops for enhancing SOC capabilities.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Proficient in SOC Operations for Industrial Environments.	K2
CO2	Skilled in Integrating IT and OT Security.	K2
CO3	Capable of Utilizing Industrial-Specific Threat Intelligence.	K3
CO4	Prepared for Incident Response and Forensics in OT.	K3
CO5	Advanced in Implementing Security Operations and Continuous Improvement.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2			2							2
CO2	3	2	3		3				2			2
CO3	3	3	2	2	3					2		2
CO4	3	3	3	3			2	2				2
CO5	3	3	3		3		2	2				3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems	Eric D. Knapp and Joel Thomas Langill	Syngress	2nd edition, 2014
2	Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS	Tyson Macaulay, Bryan L. Singer	CRC Press	1 st edition, 2012
3	Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure	Eric D. Knapp, Raj Samani	Syngress	1 st edition, 2013
4	Building an Effective Cybersecurity Program: Lessons Learned from an Industrial Control Systems Environment	Tari Schreider	Rothstein Publishing	1 st edition, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Industrial Control System Cyber Security: A Practitioner's Perspective	Liam M. Randall	Packt Publishing	1 st edition, 2020
2	Practical Industrial Cybersecurity: ICS, SCADA, and PLC Security	Philip A. Craig Jr.	Packt Publishing	1 st edition, 2017
3	The Security Analyst's Guide to Splunk	Josh Diakun, Paul R. Johnson, and Gary R. Jefress	Packt Publishing	1 st edition, 2016

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/108/105/108105062/ https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs85/preview
3	https://www.udemy.com/course/incident-response-for-cyber-professionals
4	https://nptel.ac.in/courses/108/108/108108098/ https://nptel.ac.in/courses/106/105/106105217/

SEMESTER 7

COMPUTER VISION

Course Code	25CST745	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs 30 Mins
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To cover the basics of image formation, key computer vision concepts, methods, techniques, pattern recognition, and various problems in designing computer vision and object recognition systems.
2. To enable the learners to understand the fundamentals of computer vision and machine learning models to develop applications in computer vision.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals in Computer Vision :- Camera Calibration- Pinhole camera model, Geometric Image Features - Curves, Surfaces, Analytical Image Features - Elements of Analytical Euclidean Geometry, Geometric Camera Parameters, Stereopsis - Binocular Camera Geometry, Epipolar Constraint, Binocular Reconstruction, Local Methods for Binocular Fusion, Global Methods for Binocular Fusion.	9
2	Features and Filters :- Linear Filters- Linear Filters and Convolution, Shift Invariant Linear Systems. Estimating Derivatives with Finite Differences, Noise, Edges and Gradient-based Edge Detectors Image Gradients - Computing the Image Gradient, Gradient Based Edge and Corner Detection. Filters as Templates - Normalized Correlation and Finding Patterns.	9

3	Machine Learning for Computer Vision :- Machine Learning - Introduction, Dataset for Machine Perception- Labelled and Unlabelled Data, Basics of Classification and Clustering, Multi-Class Perspective. Machine Learning for Computer Vision -Machine Learning -Deep Learning Use Cases. Machine Learning Models for Vision - Image Vision-Pretrained Model, Transfer Learning, Fine-Tuning, Convolutional Networks, Convolutional Filters, Stacking Convolutional Layers, Pooling Layers - AlexNet, VGG19, , Modular architecture - ResNet, Neural Architecture Search Design - NASNet	9
4	Segmentation and Object detection :- Segmentation Using Clustering Methods - Human vision- Grouping and Gestalt, Applications- Shot Boundary Detection, Background Subtraction, Image Segmentation by Clustering Pixels- Simple Clustering Methods, Clustering and Segmentation by K-means Object detection - YOLO, Segmentation-Mask R-CNN and Instance Segmentation, U-Net and Semantic Segmentation, Model Quality Metrics <i>A case study to compare performance of various models on a suitable dataset.</i>	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basic concepts and terminologies like Camera Calibration, Stereopsis in computer vision	K2
CO2	Apply filters for feature extraction and for finding patterns.	K3
CO3	Build different machine learning models for computer vision	K3
CO4	Implement segmentation and object detection models	K3
CO5	Analyze different machine learning models for segmentation/object detection.	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3	3								3
CO5	3	3	3	3	3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer vision: A modern approach	Forsyth, David, and Jean Ponce	Prentice hall	2011
2	Emerging topics in computer vision	Medioni, Gerard and Sing Bing Kang	PHI	2004
3	Practical Machine Learning for Computer Vision	Valliappa Lakshmanan, Martin Görner, Ryan Gillard	O'Reilly Media	2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer vision: algorithms and applications	Szeliski, Richard	Springer Science & Business Media	2010
2	Image Segmentation: Principles, Techniques, and Applications	Tao Lei, Asoke K. Nandi	John Wiley & Sons	2022
3	Deep Learning in Computer Vision Principles and Applications	Ali Ismail Awad, Mahmoud Hassaballah	CRC Press	2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	Computer Vision and Image Processing - Fundamentals and Applications by Prof. M. K. Bhuyan at IIT Guwahati https://onlinecourses.nptel.ac.in/noc23_ee39/preview
2	Computer Vision by Prof. Jayanta Mukhopadhyay at IIT Kharagpur https://onlinecourses.nptel.ac.in/noc19_cs58/preview
3	
4	Deep Learning for Computer Vision by Prof. Vineeth N Balasubramanian at IIT Hyderabad https://onlinecourses.nptel.ac.in/noc21_cs93/preview
	COVID-Net Open Source Initiative - COVIDx CT-3 Dataset https://www.kaggle.com/datasets/hgunraj/covidxct

SEMESTER S7

DATA & COMPUTER COMMUNICATION

Course Code	25CCT751	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)		Course Type	Theory

Course Objectives:

1. Enables the learners to understand the Fundamentals of Data Communication and Networking.
2. Enables the students to learn Networking Protocols and Standards.
3. Enables the learners to Explore Emerging Technologies and Trends in Networking.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of Data Communication Introduction to Data Communication: Basic components: transmitters, receivers, transmission media, Data flow types: simplex, half-duplex, full-duplex. Transmission Media: Guided media: twisted pair, coaxial, fiber optics, Unguided media: radio waves, microwaves, infrared. Data Encoding and Modulation: Digital-to-digital conversion, Analog-to-digital conversion, Digital-to-analog modulation (ASK, FSK, PSK), Analog-to-analog modulation (AM, FM, PM).	10
2	Network Models and Topologies Network Models: OSI reference model: layers and functions, TCP/IP model: layers and functions, Addressing schemes: MAC addresses, IP addresses Network Topologies: Bus, star, ring, mesh topologies: structure, advantages, disadvantages Basic Networking Devices: Routers, switches, hubs, bridges, and their roles in a network.	9

3	Data Link Layer and Network Layer Protocols Data Link Layer Protocols: Error detection and correction: CRC, Hamming code, Flow control mechanisms: stop-and-wait, sliding window, MAC protocols: CSMA/CD, CSMA/CA, Ethernet. Network Layer Protocols: IPv4 and IPv6 addressing, subnetting, Routing algorithms: distance vector, link state Routing protocols: RIP, OSPF, BGP.	11
4	Transport and Application Layer Protocols Transport Layer Protocols : TCP , UDP Application Layer Protocols: DNS, DHCP, HTTP, FTP, SMTP, SNMP Network Design: LAN and WAN planning, VLANs, wireless technologies (Wi-Fi, Bluetooth) Emerging Technologies and Future Trends in Networking: Cloud Computing and Data Centers , Internet of Things (IoT) , Edge computing, fog computing, blockchain, quantum networking (Basic concepts only).	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the basics of data communication, including transmission media and modulation techniques.	K2
CO2	Explain network models, topologies, and the role of networking devices.	K2
CO3	Apply data link and network layer protocols for efficient network communication.	K3
CO4	Analyze the use of transport and application layer protocols in network services.	K3
CO5	Explore emerging networking technologies and their future implications.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1								3
CO2	3	2	2	1								3
CO3	3	3	3	2								3
CO4	3	3	3	2								3
CO5	2	3	2	2		1	1	1	1	1	1	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data and Computer Communications	William Stallings	Pearson	10 th Edition
2	Computer Networks	Andrew S. Tanenbaum and David J. Wetherall	Pearson	5 th Edition
3	Data Communications and Networking	Behrouz A. Forouzan	McGraw-Hill Education	5 th Edition

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Communication Networks: Fundamental Concepts and Key Architectures	Alberto Leon-Garcia and Indra Widjaja	McGraw-Hill	2 nd Edition
2	Network Security Essentials: Applications and Standards	William Stallings	Pearson	6 th Edition

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/106/105/106105082/ https://nptel.ac.in/courses/117/104/117104117/
2	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105081/
3	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105082/ https://nptel.ac.in/courses/106/102/106102245/
4	https://nptel.ac.in/courses/106/105/106105183/ https://nptel.ac.in/courses/106/105/106105166/ https://nptel.ac.in/courses/106/106/106106129/ https://nptel.ac.in/courses/115/106/115106086/

SEMESTER S7

SOCIAL AND ETHICAL ISSUES OF THE INTERNET

Course Code	25CCT752	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Basic knowledge of computer networks and cybersecurity. Familiarity with ethical principles and data privacy concepts.	Course Type	Theory

Course Objectives:

1. Understand the social and ethical challenges posed by the widespread use of the internet.
2. Analyse legal frameworks and regulations governing digital spaces.
3. Assess the ethical implications of emerging technologies.
4. Develop strategies to address privacy, security, and ethical concerns in the digital world.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Social and Ethical Issues: Understanding Ethics in the Digital World - Ethics, Relationship between ethics and technology. Impact of the Internet on Society - Social consequences of internet expansion, digital inequality, technology access. Ethical concerns in internet conduct, online communities, and cyberbullying - The significance of online identity and anonymity. Privacy and Monitoring - Rights to privacy, techniques for surveillance, ethical considerations when collecting and tracking data. Case Studies - Ethical issues and scandals involving social media.	10
2	Laws and Regulations for the Internet: Internet Governance and Regulations - The worldwide and local laws that govern the internet, comparing self-regulation and government regulation	8

	(Overview only). Intellectual Property Rights (IPR) -copyright, patents, trademarks, and their significance in the context of the internet. Cybercrime and Cyber Law - Different types of cybercrimes, legislation against cybercrime, digital evidence, and forensic analysis (Detailed study). Ethical considerations of regulating content, hate speech, and censorship laws in the debate between Freedom of Speech and Censorship (Overview only). Case Studies of legal disputes - big companies involved in legal cases, challenges with determining jurisdiction in cyberspace.	
3	Data Protection and Security: Principles of data protection, GDPR, and other regulations for ethical data handling. Ethical issues in data aggregation and the commercialization of personal data in Big Data and Surveillance Capitalism. Ethical principles in cybersecurity - Proper disclosure, moral hacking, technologies with both peaceful and problematic applications (Overview only). User agreement and openness - Consent in gathering data, deceptive practices, ethical development. Case Studies - Real-life examples involving data breach and law enforcement agencies.	10
4	Social media, AI, and Emerging Technology Ethics: Ethical Issues in social media - Content moderation, biased algorithms, and misinformation (Overview only). Algorithms and Echo Chambers - Combating misinformation. Digital Identity and Online Reputation - Ethical issues in managing digital identity and online harassment. AI and Emerging Technologies -Ethical dilemmas in AI, deepfakes, content creation (Overview only). Case Studies - Social media's role in election manipulation and AI in content moderation.	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand and analyse the ethical implications of technology and the internet	K2
CO2	Evaluate legal and regulatory challenges associated with internet governance and cybercrimes	K4
CO3	Critically assess ethical practices in data handling, privacy, and cybersecurity	K4
CO4	Examine the impact of social media, AI, and algorithms on ethics and society	K3
CO5	Discuss and propose ethical solutions for challenges posed by emerging technologies	K4

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	2	-	3	-	-	-	2
CO2	3	3	1	2	2	2	1	-	-	-	-	3
CO3	3	2	3	2	-	-	-	2	-	-	-	-
CO4	2	2	2	3	1	-	-	3	2	2	-	-
CO5	3	3	2	3	2	1	-	2	1	1	2	3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics for the Information Age	Michael J. Quinn	Pearson	7th Edition, 2017
2	Cyber-ethics: Morality and Law in Cyberspace	Richard Spinello	Jones & Bartlett Learning	6th Edition, 2017
3	The Ethics of Information	Luciano Floridi	Oxford University Press	2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Ethics of Cybersecurity	Markus Christen et al.	Springer	2020
2	Cybersecurity Ethics: An Introduction	Mary Manjikian	Routledge	1st Edition, 2017
3	AI Ethics	Mark Coeckelbergh	MIT Press	2020
4	Data and Goliath: The Hidden Battles to Collect Your Data and Control Your World	Bruce Schneier	W.W. Norton & Company	2015
5	Internet Governance: The New Frontier of Global Institutions	John Mathiason	Routledge	2008

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://nptel.ac.in/courses/109106124
2	https://nptel.ac.in/courses/106105217
3	https://nptel.ac.in/courses/106104119
4	https://onlinecourses.swayam2.ac.in/cec21_ge12/preview

SEMESTER S7

INFORMATION SECURITY IN PUBLIC AND PRIVATE SECTORS

Course Code	25CCT753	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The goal of this course is to familiarize students with Security in computing, program security in the context of Public and private sectors.
2. The topics also cover the familiarization of database security and the methods of administering security in private and public domains.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Security Problem in Computing: The meaning of computer Security, Computer Criminals, Methods of Defense, Elementary Cryptography: Substitution Ciphers, Transpositions, Making “Good” Encryption algorithms, The Data Encryption Standard, The AES Encryption Algorithms, Public Key Encryptions, Uses of Encryption.	9
2	Program Security: Secure Programs, Non malicious Program Errors, viruses and other malicious code, Targeted Malicious code, controls Against Program Threats, Protection in General- Purpose operating system protected objects and methods of protection memory and add mens protection, File protection Mechanisms, User Authentication Designing Trusted O.S: Security polices, models of security, trusted O.S design, Assurance in trusted O.S. Implementation examples.	9
3	Data base Security: Security requirements, Reliability and integrity, Sensitive data, Inference, multilevel database, proposals for multilevel security. Security in Network:	9

	Threats in Network, Network Security Controls, Firewalls, Intrusion Detection Systems, Secure E-Mail.	
4	Administering Security: Security Planning, Risk Analysis, Organizational Security policies, Physical Security. Legal Privacy and Ethical Issues in Computer Security: Protecting Programs and data, Information and the law, Rights of Employees and Employers, Software failures, Computer Crime, Praia, Ethical issues in Computer Security, case studies of Ethics..	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the foundation of security problems in computing	Understand
CO2	To understand and to employ methods for program security and for protecting files	Apply
CO3	To understand and to employ methods for database security and for protecting network in public and private domains	Apply
CO4	Investigate and do administration on Organizational policies and adopt ethical policies in Security.	Analyze

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										2
CO2	3	3										2
CO3	3	3										2
CO4	3	3										2
CO5	3	3										2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Security in Computing	Charles P.Pfleeger, Shari Lawrence Pfleeger	PHI	5 th Edition, 2015
2	Cryptography and Network Analysis DVD Toolkit	A. Kahate	TMH	3 rd Edition, 2017
3	Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry	Harlan Carvey	Syngress Inc.	Edition 2,2009
4	Practical Linux Forensics: A Guide For Digital Investigators	Bruce Nikkel		2021

SEMESTER S7

ENGINEERING OF TRUSTWORTHY SECURE SYSTEMS

Course Code	25CCT754	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To address the major questions, challenges, and processes that Systems Security Engineers (SSE) face in evaluating the cyber risk and resiliency associated with a large-scale system.
2. To develop systems that are more cyber-resilient.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Define key concepts and principles of Systems Security Engineering. Summarize the role of policies, standards, procedures, and guidelines in securing systems. Outline the transferable (i.e. soft) and technical skills that effective Systems Security Engineers embody. Define the three system security engineering contexts - problem context, solution context, and trustworthiness context SIE 573 5 - as outlined in the System Security Engineering Framework. Identify the systems security outcomes, tasks, and activities relevant to each process outlined in the System Life Cycle - Technical, Technical Management, Organizational Project-Enabling, and Agreement.	11
2	Supervisory Control and Data Acquisition (SCADA) system. security techniques used in Supervisory Control and Data Acquisition (SCADA) systems. Classification of the 16 Critical Infrastructure (CI) Sectors. Overview and Application of the Risk Management Framework; how to use the Risk Management Framework(RMF).Risk Management Framework (RMF) activities, tasks, and outcomes. Development of a risk management assessment utilizing the Risk Management Framework.	9

3	Security and Privacy Controls: Utilize the National Institute of Standards and Technology (NIST) Security Control Catalog. Select security control baselines utilizing the guidelines established by the National Institute of Standards and Technology (NIST), Customize and create overlays of security controls, Documentation the control selection process. Overview and Application of the Cybersecurity Framework (CSF) Navigate the Cybersecurity Framework (CSF). Utilize the Cybersecurity Framework (CSF) to manage activities, tasks, and outcomes. Tailor the Cybersecurity Framework (CSF) to create a security plan.	11
4	Cyber Resiliency Considerations: Cyber Resiliency Engineering Framework. Interpret Cyber Resiliency Goals and Objectives. Describe Cyber Resiliency Goals and Objectives. Differentiate Cyber resiliency techniques, approaches and design principles. Prioritize Cyber resilience in the System Development Lifecycle (SDLC).	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the ability to develop and apply cyber-related engineering design considerations.	Analyse
CO2	Identify, formulate, and solve complex engineering problems in Systems Security Engineering and Cyber Resiliency	Apply
CO3	Recognize and address both ethical and professional responsibilities in cyber policy, standards and engineering.	Understand
CO4	identifying specific security controls for any shortcomings that may be uncovered during a security/compliance assessment as it relates to a specific critical infrastructure sector.	Analyse
CO5	Understanding how and where cyber resiliency factors should be considered throughout the SDLC.	Understand

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2									2
CO2	3	2	2									2
CO3	3	2	2									2
CO4	3	2	2		2							2
CO5	3	2	2		2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Security and Privacy Controls for Information Systems and Organizations, Special Publication 800-53.	National Institute of Standards and Technology (NIST)	Special Publication 800-53	Fifth Edition, 2020
2	Risk-Management Framework for Information Systems and Organizations – A System Life Cycle Approach for Security and Privacy.	National Institute of Standards and Technology (NIST)	Special Publication 800-37	second edition, 2018.
3	Engineering Trustworthy Secure Systems	National Institute of Standards and Technology (NIST)	Special Publication 800-160.	First edition, 2022
4	Developing Cyber-Resilient Systems, A Systems Security Engineering Approach	National Institute of Standards and Technology (NIST)	Special Publication 800-160	First edition, 2021

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Systems Engineering Principles	Breyan Mesmer, Michael Watson	Incoze Publications	First edition, 2022
2	Principles for Trustworthy Design of Cyber-Physical Systems.	Hild D, McEvelley M, Winstead M	MITRE Technical Report	Third Edition, 2021

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=CrLRFn5O_F8&list=PLYwpaL_SFmcArHtWmbs_vXX6soTK3WEJw
2	https://www.youtube.com/watch?v=XbZE0Xd5Rls&pp=ygU3U3VwZXJ2aXNvcnkgQ29udHJvbCBBbmQgRGF0YSBBY3F1aXNpdGlvbiAoU0NBREEpIHN5c3RlbQ%3D%3D
3	https://www.youtube.com/watch?v=kbwsxEGYgbs&pp=ygUdU2VjdXJpdHkgYW5kIFByaXZhY3kgQ29udHJvbHM%3D
4	https://www.youtube.com/watch?v=3DM2FsBSJjY&pp=ygUoIEN5YmVyaW5kIFJlc2lsaWVudY3kgRW5naW5lZXJpbmcgRnJhbWV3b3JrLg%3D%3D

SEMESTER S7

CYBER THREAT INTELLIGENCE

Course Code	25CCT755	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. Enables the learners to understand the basics of threat intelligence and how it helps organizations protect their data.
2. Enables the learners to identify and manage different threat vectors and use scanning tools to detect vulnerabilities.
3. Enables the learners to gain insights into securing applications and applying security measures throughout the development process.
4. Enables the learners to explore how SIEM platforms work, utilize AI and user behavior analytics in security, and practice threat hunting techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Threat intelligence overview Definition, Strategy and external sources, How organisation use CTI, Role of CTI analyst, Threat intelligence platforms, Threat intelligence frameworks, Security intelligence. Data security and protection Data security challenges, common pitfalls, Industry specific data security challenges, Data protection capabilities	11
2	Threat vectors and scanning Threat vector, types of threat vector, mitigate risk from threat vector, scanning, types of scanning, port scanning, network protocol analyser, vulnerability assessment tools.	8

3	Application security and testing Characteristic of security architecture, High level architectural models, security patterns, Application security overview, Application security standards and regulations, DevsecOps overview, DevsecOps Deployment, Application security Defects, Effective defenses.	10
4	SIEM platforms and Threat Hunting SIEM concepts and Benefits, SIEM Deployment, SIEM Solutions, vendors, User behaviour analytics, AI and SIEM, Apply AI concepts, Apply user behaviour analytics, AI and Cyber security, Apply AI to SIEM, Mitigate upcoming future attacks with Cyber threat Hunting.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Internal Ex	Evaluate	Analyse	Total
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 sub divisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand Threat Intelligence.	K2
CO2	Identify and Mitigate Threat Vectors.	K3
CO3	Apply Application Security Measures.	K3
CO4	Utilize SIEM Platforms.	K2
CO5	Incorporate AI and Threat Hunting.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2								2
CO2	3	2	2	2								2
CO3	3	3	2	2	1							2
CO4	3	3	3	3	1		2	2				2
CO5	3	3	3		2		2	2				2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	The Threat Intelligence Handbook: A Practical Guide for Security Teams to Unlocking the Power of Threat Intelligence	Recorded Future (Company)	Recorded Future	1 st Edition, 2020
2	Network Security Essentials	William Stallings	Pearson	6 th Edition, 2019
3	Application Security Program: A Practical Guide to Implementing Secure Software Development Lifecycle	A. Michael Houghton	CRC Press	1 st edition, 2020
4	Security Information and Event Management(SIEM) Implementation	David Miller	Packt Publishing	1 st edition, 2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software	Michael Sikorski and Andrew Honig	No Starch Press	I st Edition, 2012
2	The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws	Dafydd Stuttard and Marcus Pinto	Wiley	2 nd Edition, 2011
3	Practical Threat Hunting: Detecting and Responding to Cyber Attacks	Aditya K. Sood	Springer	I st Edition, 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.coursera.org/specializations/intro-cyber-security https://www.udemy.com/course/cyber-threat-intelligence/
2	https://www.coursera.org/learn/network-security
3	https://www.udemy.com/topic/web-application-security-tester
4	https://www.udemy.com/course/cyber-security-soc-analyst-training-siem-splunk-60-hrs

SEMESTER 7**CYBER SECURITY**

Course Code	25CST721	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Nil	Course Type	Theory

Course Objectives:

1. To teach the basic attacks, threats and vulnerabilities related to cyber security
2. To make the learner aware of cyber crimes and cyber laws
3. To give concepts of the malwares and its protection mechanisms in systems and mobile devices

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Cyber Security :- Basic Cyber Security Concepts, Layers of Security, Vulnerability, Threats, Computer Criminals, CIA Triad, Motive of Attackers, Active attacks, Passive attacks, Software attacks, Hardware attacks, Cyber Threats and its Classifications- Malware, Social Engineering, DoS/DDoS, Insider Threats, Advanced Persistent Threats (APTs), Data Breaches and Information Theft.	9
2	Cybercrime and CyberLaw :- Cybercrime, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime. Fundamentals of cyber law, Outline of legislative framework for cyber Law, History and emergence of cyber law, Outreach and impact of cyber law, Major amendments in various statutes.	9
3	Malwares and Protection against Malwares :- Virus, Worms, Trojans, Spyware, Adware, Key-logger, Ransomware, Common Methods of Malware Propagation- Email Attachments, Malicious Websites, Removable Media, File Sharing Networks, Malvertising, Protection against Malware- Antivirus/Antimalware Software, Regular	9

	Software Updates, Email Filtering, Web Filtering, Data Backup and Recovery, Strong Passwords and Multi-Factor Authentication (MFA).	
4	Mobile App Security :- Security Implications of Mobile Apps, Mobile App Permission Management and Best Practices, Risks of Location-Based Social Networks, Data Security on Mobile Devices- Importance of Data Security on Mobile Devices to Protect Sensitive Information, Risks of Unencrypted Data Storage and Communication on Mobile Platforms, Benefits of Device Encryption, Secure Messaging Apps, and Encrypted Storage Solutions.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the attacks, security mechanisms and services to user information	K2
CO2	Identify the cybercrimes and discuss the cyber laws against the crimes	K2
CO3	Discuss the malwares and the protection mechanisms against malwares	K3
CO4	Describe the issues and solutions related with mobile applications	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3										2
CO2	2	3	2									2
CO3	2	3	2									2
CO4	2	3	2									2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Security: Principles and Practices	William Stallings	Pearson	5/e, 2011
2	Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Nina Godbole, Sunit Belapure	Wiley	1/e, 2011
3	Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives	B.B.Gupta, D.P Agrawal, Haoxiang Wang.	CRC Press	1/e, 2018
4	Cyber Security Essentials	James Graham, Richard Howard, Ryan Otson	Auerbach	1/e, 2010

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/111/101/111101137/
2	https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044
3	https://www.coursera.org/learn/data-security-privacy#modules
4	https://nptel.ac.in/courses/106105217 https://archive.nptel.ac.in/courses/106/106/106106156/

SEMESTER 7**CLOUD COMPUTING**

Course Code	25CST722	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To understand the core principles, architecture, and technologies that underpin cloud computing, including virtualization, data storage, and cloud services.
2. To equip students with the skills to use cloud computing tools effectively, implement cloud-based applications, and address security challenges within cloud environments.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Cloud Computing, Types of Cloud, Working of Cloud Computing, Cloud Computing Architecture - Cloud Computing Technology, Cloud Architecture, Cloud Modelling and Design.	8
2	Virtualization - Foundations, Grid, Cloud And Virtualization, Virtualization And Cloud Computing; Data Storage And Cloud Computing - Data Storage, Cloud Storage, Cloud Storage from LANs to WANs.	9
3	Cloud Computing Services - Cloud Computing Elements, Understanding Services and Applications by Type, Cloud Services; Cloud Computing and Security - Risks in Cloud Computing, Data Security in Cloud, Cloud Security Services.	10
4	Cloud Computing Tools - Tools and Technologies for Cloud, Apache Hadoop, Cloud Tools; Cloud Applications - Moving Applications to the Cloud, Microsoft Cloud Services, Google Cloud Applications, Amazon Cloud Services.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Articulate the fundamental concepts of cloud computing, its types, and how cloud computing architecture operates.	K2
CO2	Understand and describe the foundations of virtualization, its relationship with cloud computing.	K2
CO3	Describe various cloud computing services, understand the different service models, and identify potential risks.	K3
CO4	Demonstrate proficiency in using cloud computing tools such as Apache Hadoop, and deploy applications using popular cloud platforms.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2									2
CO2	2	2	2	2								2
CO3	2	2	2	2								2
CO4	2	2	2	2								2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud Computing: A Practical Approach for Learning and Implementation	A.Srinivasan, J.Suresh	Pearson	1/e, 2014

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cloud Computing : Concepts, Technology, Security, and Architecture	Thomas Erl	Pearson	2/e, 2023
2	Cloud Computing	Sandeep Bhowmik	Cambridge University Press	1/e, 2017
3	Cloud Computing: A Hands-On Approach	Arshdeep Bahga and Vijay Madisetti	Universities Press	1/e, 2014

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://onlinecourses.nptel.ac.in/noc21_cs14/preview

SEMESTER 7
SOFTWARE ENGINEERING

Course Code	25CST723	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To Provide fundamental knowledge in the Software Development Process including Software Development, Object Oriented Design, Project Management concepts and technology trends.
2. To enable the learners to apply state of the art industry practices in Software development.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Software Engineering and Process Models - Software engineering, Software characteristics and types, Layers of Software Engineering- Process, Methods, Tools and Quality focus. Software Process models – Waterfall, Prototype, Spiral, Incremental, Agile model – Values and Principles. Requirement engineering - Functional, Non-functional, System and User requirements. Requirement elicitation techniques, Requirement validation, Feasibility analysis and its types, SRS document characteristics and its structure. <i>Case study:</i> SRS for College Library Management Software	9
2	Software design - Software architecture and its importance, Software architecture patterns: Component and Connector, Layered, Repository, Client-Server, Publish-Subscribe, Functional independence – Coupling and Cohesion <i>Case study:</i> Ariane launch failure Object Oriented Software Design - UML diagrams and relationships– Static and dynamic models, Class diagram, State diagram, Use case diagram, Sequence	10

	diagram <i>Case Studies:</i> Voice mail system, ATM Example Software pattern - Model View Controller, Creational Design Pattern types – Factory method, Abstract Factory method, Singleton method, Prototype method, Builder method. Structural Design Pattern and its types – Adapter, Bridge, Proxy, Composite, Decorator, Façade, Flyweight. Behavioral Design Pattern	
3	Coding, Testing and Maintenance: Coding guidelines - Code review, Code walkthrough and Code inspection, Code debugging and its methods. Testing - Unit testing , Integration testing, System testing and its types, Black box testing and White box testing, Regression testing Overview of DevOps and Code Management - Code management, DevOps automation, Continuous Integration, Delivery, and Deployment (CI/CD/CD), <i>Case study</i> – Netflix. Software maintenance and its types- Adaptive, Preventive, Corrective and Perfective maintenance. Boehm’s maintenance models (both legacy and non-legacy)	10
4	Software Project Management - Project size metrics – LOC, Function points and Object points. Cost estimation using Basic COCOMO. Risk management: Risk and its types, Risk monitoring and management model Software Project Management - Planning, Staffing, Organisational structures, Scheduling using Gantt chart. Software Configuration Management and its phases, Software Quality Management – ISO 9000, CMM, Six Sigma for software engineering.	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Plan the system requirements and recommend a suitable software process model.	K3
CO2	Model various software patterns based on system requirements.	K3
CO3	Apply testing and maintenance strategies on the developed software product to enhance quality.	K3
CO4	Develop a software product based on cost, schedule and risk constraints.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Software Engineering: A practitioner's approach	Roger S. Pressman	McGraw-Hill	8/e, 2014
2	Software Engineering	Ian Sommerville	Addison-Wesley	10/e, 2015
3	Design Patterns, Elements of Reusable Object Oriented Software	Erich Gamma,Richard Helm, Ralph Johnson,John Vlissides	Pearson Education Addison-Wesley	1/e, 2009

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Pankaj Jalote's Software Engineering: With Open Source and GenAI	Pankaj Jalote	Wiley India	1/e, 2024
2	Software Engineering: A Primer	Waman S Jawadekar	Tata McGraw-Hill	1/e, 2008
3	Object-Oriented Modelling and Design with UML	Michael Blaha, James Rumbaugh	Pearson Education.	2/e, 2007
4	Software Engineering Foundations : A Software Science Perspective	Yingux Wang	Auerbach Publications	1/e, 2008
5	Object-Oriented Design and Patterns	Cay Horstmann	Wiley India	2/e, 2005
6	Engineering Software Products: An Introduction to Modern Software Engineering	Ian Sommerville	Pearson Education	1/e, 2020

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.youtube.com/watch?v=Z6f9ckEElsU
2	https://www.youtube.com/watch?v=1xUz1fp23TQ
3	http://digimat.in/nptel/courses/video/106105150/L01.html
4	https://www.youtube.com/watch?v=v7KtPLhSMkU
2	https://archive.nptel.ac.in/courses/106/105/106105182/

SEMESTER S7**COMPUTER NETWORKS**

Course Code	25CST724	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To Introduce the core concepts of computer networking.
2. To Explore routing protocols and their role in network communication

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Computer Networks:- Introduction, Network Components, Network Models, ISO/OSI, TCP/IP, Physical Topology, Overview of the Internet, Protocol layering; Physical Layer- Transmission media (copper, fiber, wireless), Datagram Networks, Virtual Circuit networks, Performance.	7
2	Data Link Layer:- Error Detection and Correction - Introduction, Hamming Code, CRC, Checksum; Framing-Methods, Flow Control- Noiseless Channels, Noisy Channels; Medium Access Control- Random Access, Controlled Access; Wired LANs - IEEE Standards, Ethernet, IEEE 802.11;	11
3	Network Layer:- Logical Addressing- IPv4 and IPv6 Addresses; Internet Protocol- IPV4 and IPv6; Unicast Routing Protocols- Distance Vector Routing, Link State Routing Multicast Routing Protocols.	9
4	Transport Layer:- Transport Layer Protocols- UDP, TCP; Congestion Control- Open Loop Vs Closed Loop Congestion Control, Congestion Control in TCP; Application Layer - Application Layer Paradigms, Client-server applications, World Wide Web and HTTP, FTP. Electronic Mail, DNS; Peer-to-peer paradigm - P2P Networks.	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Comprehend the OSI and TCP/IP models, the functioning of different network layers, and the protocol stack used in computer networks.	K2
CO2	Evaluate various transmission media (copper, fiber, wireless), error detection/correction methods, and medium access control mechanisms in both wired and wireless LANs.	K2
CO3	Demonstrate a working knowledge of IPv4 and IPv6 addressing schemes, routing protocols (unicast and multicast), and apply them to network scenarios.	K3
CO4	Summarize UDP and TCP protocols, explain congestion control mechanisms, and understand client-server and peer-to-peer applications like HTTP, FTP, DNS, and P2P networks.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										3
CO2	3	3	3									3
CO3	3	3	3									3
CO4	3	3	3									3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks: A Top-Down Approach	Behrouz A Forouzan	McGraw Hill	SIE, 2017

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Networks, A Systems Approach	L. L. Peterson and B. S. Davie	Morgan Kaufmann	5/e, 2011
2	TCP/IP Architecture, design, and implementation in Linux	Sameer Seth M. Ajaykumar Venkatesulu	Wiley	1/e, 2008
3	Computer Networks	Andrew Tanenbaum	Pearson	6/e, 2021
4	Computer Networking: A Top-Down Approach Featuring Internet	J. F. Kurose and K. W. Ross	Pearson Education	8/e, 2022

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://nptel.ac.in/courses/106/105/106105183/

SEMESTER 7

MOBILE APPLICATION DEVELOPMENT

(Common to CS/CA/CM/CD/CR/AI/AM/AD)

Course Code	25CST725	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	0	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST204 OR 25CST615	Course Type	Theory

Course Objectives:

1. To impart a Comprehensive Mobile Development Knowledge
2. To give Proficiency in Flutter and Dart, UI/UX Design Skills
3. To present the Industry Practices and Deployment such as app security, testing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of Mobile Application Development: Introduction to Mobile Application Development, Overview of Mobile Platforms: iOS and Android, Introduction to Flutter: History, Features, and Benefits, Setting Up the Flutter Development Environment*, Mobile App Architectures (MVC, MVVM, and BLoC), Basics of Dart Programming Language.	9
2	User Interface Design and User Experience: Principles of Mobile UI/UX Design, Designing Responsive UIs with Flutter, Using Flutter Widgets: StatelessWidget and StatefulWidget, Layouts in Flutter: Container, Column, Row, Stack, Navigation and Routing in Flutter, Customizing UI with Themes and Styles.	9
3	Advanced Flutter Development: State Management in Flutter: Provider, Riverpod, and BLoC	9

	Networking in Flutter: HTTP Requests, JSON Parsing, RESTful APIs Data Persistence: SQLite, SharedPreferences, Hive Asynchronous Programming with Dart: Futures, async/await, and Streams	
4	Industry Practices and App Deployment: Advanced UI Components and Animations, App Security Best Practices, Testing and Debugging Flutter Applications, Publishing Apps to Google Play Store and Apple App Store, Industry Trends and Future of Mobile Development with Flutter	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the basics of mobile application development and different mobile platforms and the environment setup.	K2
CO2	Apply principles of effective mobile UI/UX design, develop responsive user interfaces using Flutter widgets.	K3
CO3	Experiment effectively with state in Flutter applications. networking and data persistence in Flutter apps.	K3
CO4	Apply security best practices in mobile app development and debug Flutter applications effectively.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	3	3	3	3	3							3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Flutter Cookbook	Simone Alessandria	Packt	2/e, 2023
2	Flutter for Beginners	Alessandro Biessek	Packt	1/e, 2019

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Flutter in Action	Eric Windmill	Manning	1/e, 2019
2	Flutter and Dart: Up and Running	Deepti Chopra, Roopal Khurana	BPB	1/e, 2023

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://www.youtube.com/watch?v=VPvVD8t02U8

SEMESTER S7

SEMINAR

Course Code	25CCS705	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	0
Credits	2	Exam Hours	NIL
Prerequisites (if any)	Nil	Course Type	PWS

Preamble: The course ‘Seminar’ is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

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

CO#	Course Outcomes
CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: Apply).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: Analyze)
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: Create)
CO4	Give a presentation about an academic document (Cognitive knowledge level: Apply).
CO5	Prepare a technical report (Cognitive knowledge level: Create)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1		2	1					3
CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or

be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 10 marks (Background Knowledge – 5 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 5).

Seminar Coordinator: 10 marks (Seminar Diary – 5 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 5).

Presentation: 20 marks to be awarded by the IEC (Clarity of presentation – 5, Interactions – 5(to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 5 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 5).

Report: 10 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

SEMESTER S7

MAJOR PROJECT (Phase 1)

Course Code	25CCP706	CIE Marks	100
Teaching Hours/Week (L: T:P: R)	0:0:0:8	ESE Marks	0
Credits	4	Exam Hours	NIL
Prerequisites (if any)	Nil	Course Type	PWS

Preamble: The course ‘Project Work’ is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives:

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

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

CO#	Course Outcomes
CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation

PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project evaluation by the guide: 30 Marks.

This mark should be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure is well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered, and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to find a topic from the guide. They do not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There were suggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the plan wasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning. Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation

B TECH CSE (CYBER SECURITY)

Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [C01]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understood to a large extent.	Shows clear evidence of having a well-defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [C03]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [C01]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentation and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		30	Phase - I Final Evaluation Marks: 30			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation						
Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
1-g	Report [C06]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly Unacknowledged content. Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standard format and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

SEMESTER 8
COMPUTER SCIENCE AND ENGINEERING
CYBER SECURITY

SEMESTER S8
IPR AND CYBER LAWS

Course Code	25CCT861	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. A comprehensive understanding of the fundamental concepts of cyberspace and cyber law, enabling them to analyse and address the challenges of regulating and securing the digital world.
2. To understand cybercrime, cyber ethics, and ethical issues in emerging technologies, enabling them to tackle related challenges effectively.
3. To equip students with a clear understanding of information security policies, legal frameworks like the IT Act, and intellectual property rights related to technology.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Fundamentals of Cyber Law and Cyber Space Introduction to cyber law, Contract Aspects in Cyber Law, Security Aspects of Cyber Law, Intellectual Property aspect in Cyber Law and Evidence aspect in Cyber Law, The criminal aspects in Cyber Law, Need for Indian Cyber Law. Cyberspace- Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	12
2	Cybercrime and Cyber Ethics Introduction to cyber crime- Definition and Origins of Cyber crime- Classifications of Cybercrime, Cyber Offences- Strategic Attacks, Types of	10

	Attacks, Security Challenges Faced by Mobile Devices. Organizational Measures for Handling Mobile Phones. Ethics in the Information Society- Principles, Participation, People, Profession, Privacy, Piracy, Protection, Power, Policy	
3	Security Policies and Information Technology Act Need for an Information Security policy, Information Security Standards- ISO, Introducing various security policies and their review process, Information Technology Act, 2000, Penalties, Adjudication and appeals under the IT Act, 2000, Offences under IT Act, 2000, Right to Information Act, 2005, IT Act, 2008 and its amendments.	9
4	Introduction to IPR Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights -Copyright in Internet - Multimedia and Copyright issues, Software Piracy, Patents- Understanding Patents, European Position on Computer related Patents, Legal position of U.S. on Computer related Patents, Indian Position on Computer related Patents, Trademarks -Trademarks in Internet, Domain name registration - Domain Name Disputes & WIPO, Databases in Information Technology - Protection of databases, Position in USA, EU and India.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the concepts of cyber law and the various components and challenges associated with cyberspace.	K2
CO2	Understand cybercrime classifications, mobile security challenges, and key ethical principles in information society.	K2
CO3	Understand the need for information security policies, key ISO standards, and the legal framework of the IT Act, including penalties, appeals, and amendments.	K2
CO4	Describe copyright and patent issues in IT, including software piracy, trademarks, domain name disputes, and database protection, with a focus on legal perspectives in the U.S., EU, and India.	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										2
CO2	2	2										2
CO3	2	2										2
CO4	2	2										2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Cyber Security and Cyber Laws	Nilakshi Jain, Ramesh Menon	Wiley	2020
2	Introduction to Information Security and Cyber Laws	Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla	Dreamtech Press	2014
3	Cyber Laws	Justice Yatindra Singh	Universal Law Publishing	2016.
4	Cyber Ethics 4.0: Serving Humanity with Values	Christoph Stückelberger , Pavan Duggal	Springer	2020
5	Cyber Laws: Intellectual property & E Commerce, Security	K. Kumar	Dominant Publisher	First Edition, 2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://www.wbnsou.ac.in/NSOU-MOOC/mooc_cyber_security.shtml
2	https://onlinecourses.swayam2.ac.in/cec22_lw07/preview
3	https://www.coursera.org/learn/data-security-privacy#modules
4	https://jurnal.fh.unila.ac.id/index.php/fiat/article/download/2667/1961/12044

SEMESTER S8**SECURITY IN WIRELESS NETWORKS**

Course Code	25CCT862	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. This course covers the overview of wireless network
2. Also give the ideas about security WLANs and wireless networks

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of Wireless Networks Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer-MAC sublayer-MAC Management SublayerWireless ATM - HIPERLAN - HIPERLAN 2, WiMax, Wireless Local Loop (WLL). Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, CDMA2000 overview- Radio and Network components, Network structure. 4G features and challenges, Technology path, IMS Architecture, Convergent Devices, 4G technologies, Advanced Broadband Wireless Access and Services.	11
2	Foundation Introduction to security of existing and emerging wireless networks, Introduction to cryptographic algorithms and protocols, Introduction to game theory, Case studies: cellular, WiFi, Bluetooth, MANET, VANET et	9
3	Security in Wireless LANs Authentication methods, Cross Domain Mobility Adaptive Authentication, AAA Architecture and Authentication for wireless LAN Roaming, Experimental Study on Security Protocols in WLANs	5

4	Security of wireless networks GSM, UMTS, WEP, IEEE 802.11i, Public Wifi hotspots, Bluetooth; Vehicular Ad-hoc Networks: vulnerabilities, challenges, Security architecture	7

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the wireless network	K2
CO2	Demonstrate fundamental techniques of secure wireless systems	K3
CO3	Examine security threats in wireless networks and design strategies to manage network security	K4
CO4	Understand the Security of wireless networks	K2
CO5	Understand the vulnerabilities of vehicular Ad-hoc networks	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1				1	1			2		2
CO2	2	3				2		1				2
CO3	2	1	2		2	1						1
CO4	2	2	2		1	1						2
CO5	2		1									1

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Wireless Communications and Networks	William Stallings	Prentice Hall	1st Edition, 2004
2	Security and Cooperation in Wireless Networks	Levente Buttyan (BME) and Jean-Pierre Hubaux (EPFL)	Cambridge University	1st Edition, 2007
3	Security and Cooperation in Wireless Networks: Thwarting Malicious and Selfish Behavior in the Age of Ubiquitous Computing	Butty L. & Hubaux J. P	Cambridge University	1st Edition, 2007
4	Mobile and Wireless Network Security and Privacy	K Makki, P Reiher, et. all.	Springer	1st Edition, 2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	3G Wireless Networks	Clint Smith. P.E., and Daniel Collins	Tata McGraw Hill	2nd Edition, 2007
2	Wireless and Mobile Network Security	Pallapa Venkataram, Satish Babu	Tata McGraw Hill	1st Edition, 2010
3	Wireless Security-Models, Threats and Solutions	Nichols and Lekka	Tata McGraw – Hill, New Delhi	1st Edition, 2006
4	Security in Computing	Charles P. Fleeger	Prentice Hall, New Delhi	1st Edition, 2009

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/pnunzdvezto?feature=shared
2	https://youtu.be/jSsehESW37c?feature=shared
3	https://youtu.be/YNmLYQWjYUY?feature=shared
4	https://youtu.be/bur9hq_abog?feature=shared

SEMESTER S8

SECURE MOBILE APPLICATION DEVELOPMENT

Course Code	25CCT863	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	A sound knowledge in Java.	Course Type	Theory

Course Objectives:

1. To understand mobile systems, interfaces, and the Android framework for app development.
2. To understand implementation of 2D graphics and multimedia techniques in Android applications.
3. To explore mobile embedded system architecture and scheduling algorithms.
4. To understand application of data storage techniques and leverage mobile cloud computing in app deployment.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Overview of Mobile App and Mobile Interface Mobile Systems Overview, Mobile Interface and Application Optimizations, Mobile Embedded System Basics, Mobile Cloud Computing Concepts, Big Data Applications in Mobile Systems, Data Security and Privacy Protection in Mobile Systems, Introduction to Mobile Apps (Android Focus), Android Framework Setup, Key Concepts of Android: App Components, Resources, Manifest Case Study: Snapchat Data Breach (2014) - Analysing the vulnerabilities in mobile systems that led to privacy violations, focusing on how improper data security and privacy protection practices contributed to the breach.	9

2	2D Graphics and Multimedia in Android Introduction to 2D Graphics Techniques in Android, Advanced UI Design, Multimedia in Android: Audio and Video Implementation Mobile Embedded System Architecture Embedded Systems Architecture, Scheduling Algorithms: FCFS, SJF, Multiprocessor, Priority Scheduling, Memory Technology in Mobile Systems, Messaging and Communication Mechanisms Case Study: <i>Stagefright Vulnerability in Android (2015)</i> - Examination of how multimedia components, particularly Android's handling of video, opened vulnerabilities for remote code execution attacks.	9
3	Data storage and SQLite Operations Internal and External Storage in Android, Secure File Management: Saving, Deleting, and Querying Space SQLite Database: Table Structure and CRUD Operations, Secure SQLite Operations, Content Provider and Secure Data Access Case Study: <i>Evernote Security Breach (2013)</i> - Focus on how weak data storage security led to breaches in a popular note-taking app, and how secure SQLite operations could have mitigated the attack.	9
4	Mobile Cloud Computing in Mobile Applications Deployment Mobile Cloud Computing Concepts, Differences Between Cloud and Mobile Cloud Computing Mobile Computing Architecture: Wireless LAN, WAN, Cellular Networks Techniques for Mobile Cloud: Virtualization, Parallel Programming, Distributed Storage, Mobile Cloud Computing Architecture, Security Challenges in Mobile Cloud, Best Practices for Secure Mobile App Deployment Case Study: <i>iCloud Hack (2014)</i> - Analysis of how mobile cloud security vulnerabilities exposed user data and what strategies could be used to prevent such breaches in mobile cloud environments.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the concepts, security challenges in mobile system and mobile applications	K2
CO2	Understand the implementation of 2D graphics, Graphical User Interface and incorporation of multimedia in Android applications	K2
CO3	Explain the concepts of general and Android based mobile embedded systems and its application, processor technology and scheduling algorithms	K2
CO4	Illustrate the storage of data from mobile applications to a mobile device	K2
CO5	Describe the techniques employed in mobile cloud	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				1						
CO2	3	1	2		2							
CO3	3	2	2									
CO4	3	1			2							
CO5	3	2			2	1						

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mobile Applications Development with Android Technologies and Algorithms	Meikang Qiu, Wenyun Dai, and Keke Gai,	Taylor and Francis	
2	Mobile Application Security	Himanshu Dwivedi, David Thiel, and Chris Clark	McGraw-Hill Education	

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mobile Applications: Design, Development, and Optimization	Tejinder S. Randhawa	Springer	2022
2	Android Boot Camp for Developers using Java, a Beginner's Guide to Creating Your First Android Apps	Corinne Hoisington	Course Technology Inc	2017
3	Android Application Development for Java Programmers	James C. Sheusi	Cengage	2013

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/rjcpzn7ty0o
2	https://youtu.be/-j1wISEOXYc
3	https://youtu.be/b1AgSvtl03g
4	https://youtu.be/LcAPj95KeSA

SEMESTER S8**NETWORK FORENSICS**

Course Code	25CCT864	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

5. Identify the significance and principles underlying networking concepts and protocols
6. Explain Network Forensics and its importance and understand Security issues of network communications.
7. Understand network forensics tools and techniques and evaluate procedure for network forensics investigation.
8. Comprehend wireless basics, authentication types, and attacks on wireless networks.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Computer Networks- Definition of Network, Need of Networks, Protocol, Types of Networks- LAN, MAN, WAN. Network Components- Twisted Pair Cable, Coaxial cable, Fiber Optic Cables, Network Interface Card, HUB, Switch, Router. OSI model and TCP/IP protocol suite, Introduction Network Protocols- IP, TCP, UDP, DHCP, DNS. Types of Topologies- RING, STAR, BUS, MESH (features, advantages, disadvantages). Classification by Component: Peer to Peer, Client/ Server.	9
2	Overview of Network Forensics: Definition, Process of Network Forensics, Importance, Advantages and Disadvantages, Application of Network Forensics. Network threats and vulnerabilities: Types of network attacks- eavesdropping, spoofing, modification, Cross-site scripting, DNS Spoofing, Routing Table Page Poisoning, ARP Poisoning,	9

	Web Jacking, Social Engineering Attacks and its types. Types of network forensics investigations: Incident Response and Proactive Investigations	
3	Identifying sources of evidence- Digital devices, Network traffic, Cloud environments, Steps for handling evidence. Data acquisition methods- Network traffic capture, Log file analysis, Memory acquisition, List Packet capture tools. Introduction to Data Preservation Technique- Write-blocking, Data encryption, Data hashing, Metadata preservation. Network Traffic Analysis Methods- Flow analysis, Packet analysis, Deep packet inspection (DPI), and Network behavior analysis. Identifying sources of evidence, learning to handle the evidence, collecting network traffic using tcpdump, Collecting network traffic using Wireshark, Collecting network logs, Acquiring memory using FTK Imager, Tapping into network traffic: Packet sniffing and analysis using Wireshark, Packet sniffing and analysis using NetworkMiner.	9
4	Introduction to Wireless Networks: Basics of wireless (IEEE 802.11) communication and security challenges. Types of Authentications: WEP, WPA and WPA-2 Encryption. Attacks on Wireless networks: Man-in-the middle (MITM), Brute-Force, Evil Twin, Rogue access points, Phishing, Wireless Jamming (Denial-of-Service Attacks), Wireless Eavesdropping. Legal challenges in network forensics: Authorization, Privacy, Data Preservation, Disclosure, Cross-Border Investigations. Digital Personal Data Protection Act, 2023: Introduction, Data, Data Fiduciary, Data Principal, Data Processor, Personal Data Breach, Need of DPDP, Key Features of DPDP	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the Basics of Networking Concepts and Protocols	Understand
CO2	Describe the significance of network forensics and the security concerns associated with network communications.	Understand
CO3	Describe the process of evidence handling, data acquisition methods, and Network Traffic Analysis methods	Analyse
CO4	Comprehend wireless basics, authentication types, and attacks on wireless networks	Understand

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Learning Network Forensics	Samir Datt	PACKT Publications	, ISBN: 9781782174905
2	Tools and techniques for network forensics	Meghanathan, N., Allam, S. R., & Moore, L. A.	arXiv preprint arXiv:1004.0570.	2010
3	Network Forensics	Ric Messier	Wiley	ISBN: 9781119328285
4	Network forensics: tracking hackers through cyberspace	Davidoff, S., & Ham, J.	Pearson	(2012)(Vol. 2014). ISBN: 9780132565110 Upper Saddle River: Prentice Hall.

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Security and Network Forensics	William J. Buchanan	CRC press publications.	2011
2	Hands-On Network Forensics	Nipun Jaswa	PACKT Publications	March 2019 ,ISBN 9781789344523
3	Network Forensics	Anchit Bijalwan	CRC press publications.	December 2021 978-0367493615

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://youtu.be/VwN91x5i25g?feature=shared
2	https://youtu.be/VklrX2IfCNk
3	https://youtu.be/VklrX2IfCNk?feature=shared
4	https://youtu.be/U_cl7QqCF3c?feature=shared

SEMESTER S8**WINDOWS AND LINUX FORENSICS**

Course Code	25CCT866	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. The goal of this course is to familiarize students with Windows and Linux OS forensic analysis in the context of Disk Forensics.
2. The topics also covers the familiarization of different tools which may explore new
3. ways to approach problems in the fields of digital forensic analysis.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Digital investigation foundation: Digital investigations and evidence, Digital crime scene investigation process, Data analysis, overview of toolkits. Computer foundations- Data organizations-booting process-Hard disk technology- Hard disk data acquisition-introduction- reading the source data-writing the output data.	9
2	Live Response: Data Collection Introduction, Live Response- Locard's Exchange Principle, Order of Volatility, When to Perform Live Response, What Data to Collect, System Time, Logged-on Users, Open Files, Network Information, Network Connections Process Information-, Process-to-Port Mapping, Process Memory, Network Status, Nonvolatile Information, Live Response Methodologies.	7

3	Collecting Process Memory, Dumping Physical Memory, Analyzing a Physical Memory Dump File Metadata, File Signature Analysis, NTFS Alternate Data Streams, Executable File Analysis: Static Analysis, Dynamic Analysis. Registry Analysis: System Information, Auto Start Locations, USB Removable Storage Devices, Mounted Devices, Portable Devices. Finding Users, Tracking User Activity.	9
4	Linux Overview, Modern Linux Systems, Forensic Analysis of Linux Systems, Linux File Types and Identification. Linux File Analysis, Crash and Core Dumps, Investigating Evidences From Linux Logs, Network Configuration Analysis, Network Security Artifacts.	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	To understand the foundation of digital investigation and methods of data analysis.	Understand
CO2	Tools and utilities can be used to collect and analyze live response data from questionable machines.	Analyse
CO3	Conduct research and investigation in the disk forensic sector.	Create
CO4	investigate and do research on Linux systems in order to create forensic tools.	Create

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										2
CO2	3	2										2
CO3	3	2										2
CO4	3	2										2
CO5	3	2	2	2	2							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Windows Forensic Analysis DVD Toolkit	Harlan Carvey	Syngress Inc.	Edition 2,2009
2	Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry	Harlan Carvey	Syngress Inc.	Edition 2,2009
3	Practical Linux Forensics: A Guide For Digital Investigators	Bruce Nikkel		2021

SEMESTER S8

NEXT GENERATION INTERACTION DESIGN

(Common to CS/CR/CM/CA/CD/AM/AD/CN/CC/CI/CG)

Course Code	25CST865	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of the principles of interaction design and their application in augmented reality (AR) and virtual reality (VR) environments.
2. To equip learners with practical skills in developing, prototyping, and evaluating AR/VR applications, focusing on user-centered design and advanced interaction techniques.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Interaction Design and AR/VR :- Fundamentals of Interaction Design - Principles of interaction design, Human-computer interaction (HCI) basics, User experience (UX) design principles; Introduction to AR and VR - Overview of AR and VR technologies (Key differences and Application), Overview of AR/VR hardware (headsets, controllers, sensors), Software tools and platforms for AR/VR development.	10
2	User-Centered Design and Prototyping :- Understanding User Needs and Context - User research methods, Personas and user journey mapping, Contextual inquiry for AR/VR, Designing for AR/VR Environments, Spatial design principles, Immersion and presence in AR/VR, User interface (UI) design for AR/VR; Prototyping and Testing - Rapid prototyping technique, Usability testing methods, Iterative design and feedback loops.	10
3	Advanced Interaction Techniques :-	13

	Gesture - Designing for gesture-based interaction, Implementing gesture controls in AR/VR applications; Voice - Voice recognition technologies, Integrating voice commands in AR/VR; Haptic Feedback and Sensory Augmentation - Understanding haptic feedback and tactile interactions; Eye Gaze - Designing and integrating Eye Gaze in VR; Spatial Audio; Microinteraction; Motion capture and tracking technologies; Natural Language Interaction and conversational interfaces; Type of IoT sensors and uses.	
4	Implementation, Evaluation, and Future Trends :- Developing AR/VR Projects - Project planning and management, Collaborative design and development, Case studies of successful AR/VR projects; Evaluating AR/VR Experiences - Evaluation methods and metrics, Analyzing user feedback, Refining and improving AR/VR applications; Future Trends and Ethical Considerations- Emerging technologies in AR/VR, Ethical implications of AR/VR, Future directions in interaction design for AR/VR.	11

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

<i>Attendance</i>	<i>Internal Ex</i>	<i>Evaluate</i>	<i>Analyse</i>	<i>Total</i>
5	15	10	10	40

Criteria for Evaluation(Evaluate and Analyse): 20 marks

- The students must be directed to measure the quality of the interfaces / GUI based on various techniques such as user testing.
- The students may be assessed based on their ability to analyze various performance of the interfaces /GUIs.

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 3 subdivisions. Each question carries 9 marks. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply fundamental interaction design principles and human-computer interaction (HCI) concepts to create effective and intuitive user experiences in AR/VR applications.	K3
CO2	Demonstrate proficiency in using AR/VR hardware and software tools for the development and prototyping of immersive environments.	K3
CO3	Conduct user research and apply user-centered design methodologies to tailor AR/VR experiences that meet specific user needs and contexts.	K4
CO4	Implement advanced interaction techniques such as gesture controls, voice commands, haptic feedback, and eye gaze in AR/VR applications to enhance user engagement and immersion.	K3
CO5	Evaluate AR/VR projects, utilizing appropriate evaluation methods and metrics, and propose improvements based on user feedback and emerging trends in the field.	K5

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3								3
CO2	3	3	3	3	3							3
CO3	3	3	3	3	3							3
CO4	3	3	3	3	3							3
CO5	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Augmented Reality - Theory, Design and Development	Chetankumar G Shetty	McGraw Hill	1/e, 2023
2	Virtual Reality and Augmented Reality: Myths and Realities	Ralf Doerner, Wolfgang Broll, Paul Grimm, and Bernhard Jung	Wiley	1/e, 2018
3	Augmented Reality: Principles and Practice	Dieter Schmalstieg and Tobias Hollerer	Pearson	1/e, 2016
4	Human-Computer Interaction	Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale	Pearson	3/e, 2004
5	Evaluating User Experience in Games: Concepts and Methods	Regina Bernhaupt	Springer	1/e, 2010
6	Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics	Bill Albert, Tom Tullis	Morgan Kaufman	2/e, 2013
7	The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything	Robert Scoble and Shel Israel	Patrick Brewster	1/e, 2016
8	Augmented Reality and Virtual Reality: The Power of AR and VR for Business	M. Claudia tom Dieck and Timothy Jung	Springer	1/e, 2019

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	Interaction Design https://archive.nptel.ac.in/courses/107/103/107103083/
2	Virtual Reality https://archive.nptel.ac.in/courses/106/106/106106138/
3	Augmented Reality https://www.youtube.com/watch?v=WzfDo2Wpxks

SEMESTER S8**INTRODUCTION TO ALGORITHMS**

(Common to CS/CA/CM/CD/CR/AD/AM)

Course Code	25CST831	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To give proficiency in analysing algorithm efficiency and solve a variety of computational problems, including sorting, graph algorithms.
2. To provide an understanding in algorithmic problem-solving techniques, including Divide and Conquer, Greedy Strategy, Dynamic Programming, Backtracking, and Branch & Bound algorithms.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Algorithm Analysis Time and Space Complexity- Asymptotic notation, Elementary operations and Computation of Time Complexity-Best, worst and Average Case Complexities- Complexity Calculation of simple algorithms Recurrence Equations: Solution of Recurrence Equations – Iteration Method and Recursion Tree Methods	9
2	Trees - Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive and non- recursive), applications. Binary search tree – creation, insertion and deletion and search operations, applications; Graphs – representation of graphs, BFS and DFS (analysis not required), Topological Sorting.	9

3	Divide and Conquer - Control Abstraction, Finding Maximum and Minimum, Costs associated element comparisons and index comparisons, Binary Search, Quick Sort, Merge Sort - Refinements; Greedy Strategy - Control Abstraction, Fractional Knapsack Problem, Minimum Cost Spanning Trees – PRIM's Algorithm, Kruskal's Algorithm, Single Source Shortest Path Algorithm - Dijkstra's Algorithm.	9
4	Dynamic Programming - The Control Abstraction- The Optimality Principle - Matrix Chain Multiplication, Analysis; All Pairs Shortest Path Algorithm - Floyd-Warshall Algorithm; The Control Abstraction of Backtracking – The N-Queens Problem. Branch and Bound Algorithm for Travelling Salesman Problem.	9

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify algorithm efficiency using asymptotic notation, compute complexities, and solve recurrence equations	K3
CO2	Use binary trees and search trees, and apply graph representations, BFS, DFS, and topological sorting	K3
CO3	Use divide and conquer to solve problems like finding maximum/minimum, binary search, quick sort, and merge sort	K3
CO4	Apply greedy strategies to solve the fractional knapsack problem, minimum cost spanning trees using Prim's and Kruskal's algorithms, and shortest paths with Dijkstra's algorithm.	K3
CO5	Understand the concepts of Dynamic Programming, Backtracking and Branch & Bound	K2

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									1
CO2	2	3	2	2								2
CO3	3	3	3	2								2
CO4	2	2										2
CO5	2	3	2									2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Algorithms	T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein	Prentice-Hall India	4/e, 2022
2	Fundamentals of Computer Algorithms	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran	Universities Press	2/e, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Algorithm Design	Jon Kleinberg, Eva Tardos	Pearson	1/e, 2005
2	Algorithms	Robert Sedgewick, Kevin Wayne	Pearson	4/e, 2011
3	The Algorithm Design Manual	Steven S. Skiena	Springer	2/e, 2008

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105164/

SEMESTER S8**WEB PROGRAMMING**

Course Code	25CST832	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	25EST203	Course Type	Theory

Course Objectives:

1. To equip students with the knowledge and skills required to create, style, and script web pages using HTML5, CSS, JavaScript, and related technologies.
2. To provide hands-on experience with modern web development tools and frameworks such as React, Node.js, JQuery, and databases, enabling students to design and build dynamic, responsive, and interactive web applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Creating Web Page using HTML5 - Introduction, First HTML5 example, Headings, Linking, Images, Special Characters and Horizontal Rules, Lists, Tables, Forms, Internal Linking, meta Elements, HTML5 Form input Types, Input and datalist Elements and autocomplete Attribute, Page-Structure Elements; Styling Web Page using CSS - Introduction, Inline Styles, Embedded Style Sheets, Linking External Style Sheets, Positioning Elements:, Absolute Positioning, z-index, Positioning Elements: Relative Positioning, span, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types and Media Queries, Drop-Down Menus; Extensible Markup Language - Introduction, XML Basics, Structuring Data, XML Namespaces, Document Type Definitions (DTDs), XML Vocabularies	9
2	Scripting language - Client-Side Scripting, Data Types, Conditionals, Loops, Arrays , Objects , Function Declarations vs. Function Expressions , Nested Functions , The Document Object Model (DOM) - Nodes and NodeLists, Document Object, Selection Methods, Element Node Object, Event Types	9

	Asynchronous JavaScript and XML - AJAX : Making Asynchronous Requests , Complete Control over AJAX , Cross-Origin Resource Sharing JavaScript library - jQuery - jQuery Foundations - Including jQuery, jQuery Selectors, Common Element Manipulations in jQuery, Event Handling in jQuery	
3	JavaScript runtime environment : Node.js - The Architecture of Node.js, Working with Node.js, Adding Express to Node.js; Server-side programming language : PHP - What Is Server-Side Development? Quick tour of PHP, Program Control , Functions , Arrays , Classes and Objects in PHP , Object-Oriented Design ; Rendering HTML : React - ReactJS Foundations : The Philosophy of React, What is a component? Built- in components, User- defined components - Types of components, Function Components, Differences between Function and Class Components	9
4	SPA – Basics, Angular JS; Working with databases - Databases and Web Development, SQL, Database APIs, Accessing MySQL in PHP; Web Application Design - Real World Web Software Design, Principle of Layering , Software Design Patterns in the Web Context, Testing; Web services - Overview of Web Services - SOAP Services, REST Services, An Example Web Service, Web server - hosting options	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop structured web pages with HTML5 and style them using CSS techniques, including positioning, media queries, and the box model.	K3
CO2	Write client-side scripts using JavaScript and utilize jQuery for DOM manipulation, event handling, and AJAX requests to create responsive and interactive user interfaces.	K3
CO3	Build and deploy server-side applications using Node.js, Express, and PHP, and integrate databases using SQL to store and retrieve data for dynamic content generation.	K3
CO4	Utilize React for building component-based single-page applications (SPAs), understanding the fundamental principles of component architecture, and leveraging AngularJS for web application development.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		3							3
CO2	3	3	3		3							3
CO3	3	3	3		3							3
CO4	3	3	3		3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Web Development	Randy Connolly, Ricardo Hoar	Pearson	1/e, 2017
2	Building User Interfaces with ReactJS - An Approachable Guide	Chris Minnick	Wiley	1/e, 2022
3	Internet & World Wide Web - How to Program	Paul J. Deitel, Harvey M. Deitel, Abbey Deitel	Pearson	1/e, 2011
4	SPA Design and Architecture: Understanding Single Page Web Applications	Emmit Scott	Manning Publications	1/e, 2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	A Hand Book On Web Development : From Basics of HTML to JavaScript and PHP	Pritma Jashnani	Notion press	1/e, 2022
2	Advanced Web Development with React	Mohan Mehul	BPB	1/e, 2020
3	JavaScript Frameworks for Modern Web Development	Tim Ambler, Sufyan bin Uzayr, Nicholas Cloud	Apress	1/e, 2019

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/106/106106222/
2	https://archive.nptel.ac.in/courses/106/106/106106156/

SEMESTER S8
SOFTWARE TESTING

Course Code	25CST833	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To Cultivate proficiency in software testing methodologies and techniques.
2. To Foster expertise in software testing tools and technologies.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to Software Testing & Automation:- Introduction to Software Testing - Concepts, importance of testing, software quality, and real-world failures (e.g., Ariane 5, Therac 25); Software Testing Processes - Levels of thinking in testing; Testing Terminologies - Verification, validation, fault, error, bug, test cases, and coverage criteria; Types of Testing - Unit, Integration, System, Acceptance, Performance (stress, usability, regression), and Security Testing; Industry Trends - AI in test case automation, Introduction to GenAI in testing; Testing Methods - Black-Box, White-Box, and Grey- Box Testing; Automation in Testing - Introduction to automation tools (e.g., Selenium, Cypress, JUnit); Case Study- Automation of Unit Testing and Mutation Testing using JUnit.	8
2	Unit Testing, Mutation Testing & AI-Driven Automation:- Unit Testing- Static and Dynamic Unit Testing, control flow testing, data flow testing, domain testing; Mutation Testing- Mutation operators, mutants, mutation score, and modern mutation testing tools (e.g.,	8

	Muclipse); JUnit Framework - Automation of unit testing, frameworks for testing in real-world projects; AI in Testing - GenAI for test case generation and optimization, impact on automation; Industry Tools - Application of AI-driven testing tools in automation and predictive testing; Case Study - Mutation testing using JUnit, AI-enhanced test case automation.	
3	Advanced White Box Testing & Security Testing:- Graph Coverage Criteria - Node, edge, and path coverage; prime path and round trip coverage; Data Flow Criteria - du paths, du pairs, subsumption relationships; Graph Coverage for Code - Control flow graphs (CFGs) for complex structures (e.g., loops, exceptions); Graph Coverage for Design Elements - Call graphs, class inheritance testing, and coupling data-flow pairs; Security Testing - Fundamentals, tools (OWASP, Burp Suite), and their role in protecting modern applications; Case Study - Application of graph based testing and security testing using industry standard tools.	10
4	Black Box Testing, Grey Box Testing, and Responsive Testing:- Black Box Testing - Input space partitioning, domain testing, functional testing (equivalence class partitioning, boundary value analysis, decision tables, random testing); Grey Box Testing - Introduction, advantages, and methodologies (matrix testing, regression testing, orthogonal array testing); Performance Testing - Network latency testing, browser compatibility, responsive testing across multiple devices (e.g., BrowserStack, LambdaTest); Introduction to PEX - Symbolic execution, parameterized unit testing, symbolic execution trees, and their application; GenAI in Testing - Advanced use cases for predictive and responsive testing across devices and environments; Case Study- Implementation of black-box, grey-box, and responsive testing using PEX and AI-driven tools.	10

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the ability to apply a range of software testing techniques, including unit testing using JUnit and automation tools.	K2
CO2	Illustrate using appropriate tools the mutation testing method for a given piece of code to identify hidden defects that can't be detected using other testing methods.	K3
CO3	Explain and apply graph coverage criteria in terms of control flow and data flow graphs to improve code quality.	K2
CO4	Demonstrate the importance of black-box approaches in terms of Domain and Functional Testing	K3
CO5	Illustrate the importance of security, compatibility, and performance testing across devices.	K3
CO6	Use advanced tools like PEX to perform symbolic execution and optimize test case generation and also leverage AI tools for automated test case prediction and symbolic execution with PEX.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3	3							3
CO3	3	3	3									3
CO4	3	3	3	3								3
CO5	3	3	3		3							3
CO6	3	3	3	3	3							3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Software Testing.	Paul Ammann, Jeff Offutt	Cambridge University Press	2/e, 2016
2	Software Testing and Quality Assurance: Theory and Practice	Kshirasagar Naik, Priyadarshi Tripathy	Wiley	1/e, 2008

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Software Testing	Ron Patten	Pearson	2/e, 2005
2	Software Testing: A Craftsman's Approach	Paul C. Jorgensen	CRC Press	4/e, 2017
3	Foundations of Software Testing	Dorothy Graham, Rex Black, Erik van Veenendaal	Cengage	4/e, 2021
4	The Art of Software Testing	Glenford J. Myers, Tom Badgett, Corey Sandler	Wiley	3/e, 2011

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1	https://archive.nptel.ac.in/courses/106/101/106101163/
2	https://archive.nptel.ac.in/courses/106/101/106101163/
3	https://archive.nptel.ac.in/courses/106/101/106101163/
4	https://archive.nptel.ac.in/courses/106/101/106101163/

SEMESTER S8**INTERNET OF THINGS**

Course Code	25CST834	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NA	Course Type	Theory

Course Objectives:

1. To give an understanding in the Internet of Things, including the components, tools, and analysis through its fundamentals and real-world applications.
2. To enable the students to develop IoT solutions including the softwares and programming of Raspberry Pi hardware.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction to IoT - Physical Design of IoT, Logical Design of IoT, IoT levels and Deployment templates, Domain Specific IoT- Home automation, Energy, Agriculture, Health and lifestyle.	9
2	IoT and M2M-M2M, Difference between IoT and M2M, Software Defined Networking, Network Function virtualization, Need for IoT System Management, Simple Network Management Protocol(SNMP), NETCONF, YANG; LPWAN - LPWAN applications, LPWAN technologies, Cellular (3GPP) and Non 3GPP standards, Comparison of various protocols like Sigfox, LoRA, LoRAWAN, Weightless, NB-IoT, LTE-M.	9
3	Developing IoT - IoT design methodology, Case study on IoT system for weather monitoring, Motivations for using python, IoT-system Logical design using python, Python Packages of Interest for IoT - JSON, XML, HTTPlib & URLLib, SMTPLib	9
4	Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi, Interfacing an LED and switch with Raspberry Pi, Other IoT devices- PcDino, Beagle bone Black, Cubieboard, Data Analytics for IoT	9

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand domain-specific applications and apply the principles of IoT, including physical and logical design and deployment templates	K2
CO2	Use the principles of IoT and M2M, their differences, and key concepts like SDN, NFV, and essential management protocols.	K3
CO3	Develop and apply IoT design methodology, utilize Python for logical system design, and leverage key Python packages through practical case studies.	K3
CO4	Experiment using Raspberry Pi with Python to control LEDs and switches, interface with other IoT devices.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3							2		3
CO2	3	3	3							2		3
CO3	3	3	3	2						2		3
CO4	3	3	3	2						2		3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Internet of Things - a Hands On Approach.	Arshdeep Bahga, Vijay Madiseti	Universities Press	1/e, 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Internet of Things : Architecture and Design Principles	Rajkamal	McGraw Hill	2/e, 2022
2	The Internet of Things –Key applications and Protocols	Olivier Hersent, David Boswarthick, Omar Elloumi	Wiley	1/e, 2012
3	IoT fundamentals : Networking technologies, Protocols and use cases for the Internet of things	David Hanes Gonzalo. Salgueiro, Grossetete, Robert Barton	Cisco Press	1/e, 2017

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1	https://archive.nptel.ac.in/courses/106/105/106105166/
2	https://archive.nptel.ac.in/courses/108/108/108108179/

SEMESTER 8

COMPUTER GRAPHICS

Course Code	25CST835	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objective:

1. To provide strong technological concepts in computer graphics including the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basics of Computer graphics - Basics of Computer Graphics and its applications. Video Display devices - LED, OLED, LCD, PDP and FED and reflective displays. Random and Raster scan displays and systems. Line and Circle drawing Algorithms - Line drawing algorithms- Bresenham's algorithm, Liang-Barsky Algorithm, Circle drawing algorithms - Midpoint Circle generation algorithm, Bresenham's Circle drawing algorithm.	10
2	Geometric transformations - 2D and 3D basic transformations - Translation, Rotation, Scaling, Reflection and Shearing, Matrix representations and homogeneous coordinates. Filled Area Primitives - Scan line polygon filling, Boundary filling and flood filling.	10
3	Transformations and Clipping Algorithms - Window to viewport transformation. Cohen Sutherland and Midpoint subdivision line clipping	8

	algorithms, Sutherland Hodgeman and Weiler Atherton Polygon clipping algorithms.	
4	Three dimensional graphics - Three dimensional viewing pipeline. Projections- Parallel and Perspective projections. Visible surface detection algorithms- Back face detection, Depth buffer algorithm, Scan line algorithm, A buffer algorithm.	8

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. - Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	- Each question carries 9 marks. - Two questions will be given from each module, out of which 1 question should be answered. - Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the principles of computer graphics and displays	K2
CO2	Illustrate line drawing, circle drawing and polygon filling algorithms	K3
CO3	Illustrate 2D and 3D basic transformations and matrix representation	K3
CO4	Demonstrate different clipping algorithms and 3D viewing pipeline.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3									3
CO2	3	3	3	3								3
CO3	3	3	3	3								3
CO4	3	3	3	3								3

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Computer Graphics : Algorithms and Implementations	D. P. Mukherjee, Debasish Jana	PHI	1/e, 2010
2	Computer Graphics with OpenGL	Donald Hearn, M. Pauline Baker and Warren Carithers	PHI	4/e, 2013

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Flat Panel Displays	Jiun-Haw Lee, I-Chun Cheng, Hong Hua, Shin-Tson Wu	Wiley	1/e, 2020
2	Computer Graphics and Multimedia	ITL ESL	Pearson	1/e, 2013
3	Computer Graphics	Zhigang Xiang and Roy Plastock	McGraw Hill	2/e, 2000
4	Principles of Interactive Computer Graphics	William M. Newman and Robert F. Sproull	McGraw Hill	1/e, 2001
5	Procedural Elements for Computer Graphics	David F. Rogers	McGraw Hill	1/e, 2017
6	Computer Graphics	Donald D Hearn, M Pauline Baker	Pearson	2/e, 2002

Video Links (NPTEL, SWAYAM...)	
Sl.No.	Link ID
1.	Computer Graphics By Prof. Samit Bhattacharya at IIT Guwahati https://onlinecourses.nptel.ac.in/noc20_cs90/preview

SEMESTER S3/S4**ECONOMICS FOR ENGINEERS**

Course Code	25HUT346	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide students with an understanding of fundamental economic principles essential for effective decision-making in engineering contexts.
2. To enable students to apply economic analysis to production decisions, cost management, and market strategies in engineering practice.
3. To equip students with the ability to evaluate macroeconomic scenarios, financial methods, and investment decisions relevant to engineering projects.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility –Demand: Factors determining demand – Law of Demand – Demand curve- Price elasticity of demand- measurement of price elasticity and its applications – Supply: factors determining supply - Law of supply – Supply curve- Equilibrium price determination- Changes in demand and supply and its effects on equilibrium price and quantity Production: Production function - Law of variable proportion –Returns to scale- Cobb-Douglas Production Function	6
2	Cost: Cost concepts – Private cost and social cost – Sunk cost – Opportunity cost -Explicit and implicit cost –Short run cost curves –Long run average cost curve -Revenue concepts – Break-even point Market: Perfect Competition – Monopoly - Monopolistic Competition (features and equilibrium of a firm) - Oligopoly – Features – Kinked demand model	6

3	National income: Concepts (GDP, GNP and NNP)– Final goods and Intermediate goods - Methods of Estimation –output method – expenditure method-- Difficulties in the measurement of national income. Inflation: Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Repo and reverse repo rate	6
4	Value Analysis and value Engineering: Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure Capital Budgeting: Time value of money - Net Present Value Method - Benefit Cost Ratio – Internal Rate of Return – Payback – Accounting Rate of Return.	6

Course Assessment Method
(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/Case Study/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
- Minimum 1 and Maximum 2 Questions from each module. - Total of 6 Questions, each carrying 3 marks (6x3 =18 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. (4x8 = 32 marks)	50

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems and national income.	K2
CO4	Make use of the possibilities of value analysis and engineering, and take investment decisions through capital budgeting techniques.	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	-	-	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	-

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012
4	Financial Management	I M Pandey	Vikas Publishing House	2015

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7 TH Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001
5	Financial Management: Theory and Practice	Prasanna Chandra	Mc Graw Hill	2007

SEMESTER S8

MAJOR PROJECT (PHASE – II)

Course Code	25CCP80 6	CIE Marks	100
Teaching: Hours/Week (L: T:P: R)	0:0:0:8	ESE Marks	NIL
Credits	4	Exam Hours	NIL
Prerequisites (if any)	Nil	Course Type	PWS

Preamble: The course ‘Project Work’ is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives:

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

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

CO#	Course Outcomes
CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: Apply).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: Apply).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: Apply).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: Apply).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: Analyze).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: Apply).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO#	Broad PO	PO#	Broad PO
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Target

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks)

Project progress evaluation by guide: 20 Marks.

- Two interim evaluations by the Evaluation Committee: 40 Marks (20 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: 30 Marks
- Quality of the report evaluated by the evaluation committee: 10 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises Project coordinator, a senior faculty from a sister department).

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide.

Project evaluation by the guide: 20 Marks.

This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (2)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (5)

Individual Contribution: The contribution of each student at various stages. (5)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation - 1

No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team . There is fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-b	Adherence to project schedule. [CO4] [Group Evaluation]	5	Little or no evidence of continued planning or scheduling of the project. The students did not stick to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Good evidence of planning done and being followed up to a good extent after phase I. Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control tool to track the project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

2-c	Interim Results. [CO6] [Group assessment]	5	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-d	Presentation [Individual assessment]	5	Very poor presentation and there is no interim results. The student has no idea about the project proposal.	Presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 1 Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-e	Application of engineering knowledge [CO1] [Individual Assessment]	10	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-f	Involvement of individual members [CO3] [Individual Assessment]	5	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-g	Results and inferences upon execution [CO5] [Group Assessment]	5	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-h	Documentation and presentation. [CO6] [Individual assessment]	5	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

Phase-II Interim Evaluation - 2 Total Marks: 20

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation						
No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-i	Engineering knowledge. [CO1] [Group Assessment]	10	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedure and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-j	Relevance of the project with respect to societal and/or industrial needs. [Group Assessment] [CO2]	5	The project as a whole do not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to the society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contribution while solving the problem in a professional and/ or ethical manner.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-k	Innovation / novelty / Creativity [CO5] [Group Assessment]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appears to be practical. There is still lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/ or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-1	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	10	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies is not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

2-m	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	5	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides needs to be more professional.	Presentation slides follow a good style format and there are only a few issues. Organization of the slides is good. Most of references are cited properly. The flow is good and team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed. Results/ inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	5	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/ communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Final Evaluation, Marks: 30						

EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-o	Report [CO6]	30	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is lack of formatting consistency.	Project report shows evidence of systematic documentation. Report is mostly following the standard style format and there are only a few issues. Organization of the report is good. Mostly consistently formatted. Most of references/sources are cited/acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase - II Project Report Marks: 10						

