



# Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Honours/Minor Degree Programme

for

Bachelor of Technology

in

Information Technology

(R-2022 Curriculum)

(As per AICTE guidelines, with effect from the Academic Year 2024-25)

## Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated, and taken forward in a systematic manner. Therefore, autonomy for Vidyalankar Institute of Technology is not merely a transition from pre-cooked syllabi to self-designed curriculum. The autonomous curriculum of the Institute offers required academic flexibility with emphasis on industry requirements and market trends, employability and problem-solving approach which leads to improving competency level of learners with diverse strengths. In line with this, the curriculum framework designed is **Choice Based Credit and Grading System (CBCGS)**. The number of credits for each category of courses learnt by learners, internships and projects is finalized considering the scope of study and the ability that a learner should gain through the programme. The overall credits and approach of curriculum proposed are in line with the AICTE model curriculum.

The curriculum comprises courses from various categories like basic sciences, humanities and social sciences, engineering sciences, general education, and branch-specific courses, including professional electives and open electives. The curriculum has core courses of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. These courses are completed by the third year of the engineering programme that enables learners to prepare for higher education during their final year. Professional elective courses, that begin from third year of programme, offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique professional elective courses based on industrial requirements and organizing them into tracks is a salient feature of this curriculum, ensuring employability. Open Elective courses cover multi-disciplinary, special skill development, project management and similar knowledge that make learners capable of working in an industrial environment.

For holistic development of learners, apart from technical courses, Humanities and Social Science courses develop the required soft-skills and attitude amongst learners. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking, Wellness-body, Mind & Spirit, Indian Traditional Knowledge System under General Education category. These general education courses aim to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses. In addition to this, the curriculum is augmented with Life Enrichment audit courses for knowledge inspiring experience.

Additionally, curriculum provides add-on Honours/Minor degree that involves field/ domain study. Learner can avail this degree by completing requirement of additional 18 credits.

Thus, the academic plan of VIT envisages a shift from summative to formative and competency-based learning system which will enhance learner's ability towards higher education, employability and entrepreneurship.



Chairman, Board of Studies  
Department of Information Technology  
Vidyalankar Institute of Technology



Chairman, Academic Council  
Vidyalankar Institute of Technology

### **[A] Guidelines for Award of Honours/ Minor Degree Programme**

Honours and Minor Degree programme is introduced in order to facilitate learners to enhance the depth of knowledge, diversity, breadth and skills in emerging fields. An Honours or Minor Degree typically refers to a higher level of academic achievement either for research orientation or for improving employability. Learners can select any Honours or Minor Degree programme as per his/her choice.

In our curriculum, learners can choose to avail Honours/ Minor Degree programme by completing requirements of 18 credits, which will be over and above the minimum credits required for B.Tech. degree i.e. credit requirement for the award of degree programme and Honours/ Minor degree programme are required to be explicitly carried out. Learners shall opt for Honours or Minor specialisations during the break of Semester 5 and Semester 6. **Learners may complete the B.Tech. Degree programme without opting for Honours/Minor degree programme** i.e. opting for Honours/ Minor Degree programme is not mandatory as a part of B.Tech. degree programme

**For an Honours/ Minor Degree, the learner shall select an Honours/ Minor programme offered by his/her home department.**

#### **Eligibility Criteria**

- Basic eligibility for opting for Honours/Minor shall be minimum CGPA of 6.75 at the end of 4th semester and earned 80 credits from Sem 1 to Sem 4 (41 credits for DSY students).
- If student has already completed any course(s) that is listed in the chosen Honours/ Minor degree programme, as additional learning course(s), then the transfer credits for such course(s) can be carried out towards Honours/ Minor degree programme.
- For a student to get Honours/ Minor degree, it is mandatory that the student completes the relevant courses before graduating.

**Syllabus Scheme Template**

Course		Head of Learning	Preferred Semester	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name				ISA	MSE	ESE	
HM01	Industry Interaction	Theory	Break of Sem5 and Sem6	1	25	-	-	025
HMXX	Honours / Minor Degree Course 1	Theory	6	2	15	20	40	075
HMXX	Honours / Minor Degree Course 1 Lab	Practical	6	1	25	-	25	050
HM02	Survey Report/ Paper	Theory	Break of Sem6 and Sem7	2	25	-	25	050
HMXX	Honours / Minor Degree Course 2	Theory	7	2	15	20	40	075
HMXX	Honours / Minor Degree Course 2 Lab	Practical	7	1	25	-	25	050
HM03	Seminar	Theory	Break of Sem7 and Sem8	2	25	-	25	050
HMXX	Honours / Minor Degree Course 3	Theory	8	2	15	20	40	075
HMXX	Honours / Minor Degree Course 3 Lab	Practical	8	1	25	-	25	050
HM04	Capstone Project	Practical	8	4	75	-	50	125
<b>Total</b>				<b>18</b>				

**[B] Honours/ Minor Degree Programmes offered to B.Tech. Information Technology**

The Institute offers the listed Honours Degree Programme for learners of B.Tech. Information Technology  
**Honours/ Minor Degree Programmes Offered**

Sr. No.	Honours/Minor Degree Programme	Department offering Honours	Honours applicable for	Minors applicable for
1	User Interface and User Experience (UI/UX)	Information Technology	All B.Tech. Information Technology, Computer Engineering students, Electronics and Computer Science and Electronics and Telecommunication Department.	UG Engineering students of Biomedical Department.
2	Blockchain	Information Technology	All B.Tech. Information Technology, Computer Engineering students, Electronics and Computer Science and Electronics and Telecommunication Department.	UG Engineering students of Biomedical Department.
3	Next-Gen Artificial Intelligence and Machine Learning (Next-Gen AI&ML)	Information Technology	B.Tech. Information Technology students who have opted for AI&ML specialization track.	None
4	Next-Gen Data Science (Next-Gen DS)	Information Technology	B.Tech. Information Technology students who have opted for DS specialization track.	None
5	Next-Gen Cyber Security	Information Technology	B.Tech. Information Technology and Computer Engineering students who have opted for Cyber Security specialization track.	None

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Sr. No.	Honours/Minor Degree Programme	Department offering Honours	Honours applicable for	Minors applicable for
6	Next-Gen Internet of Things	Electronics and Telecommunication	B.Tech. Information Technology students who have opted for Internet of Things specialization track.	As stated in Honours/Minor Degree document of Electronics and Telecommunication department

**List of courses under each Honours/ Minor Programme:**

**1. User Interface and User Experience (UI/UX)**

Semester	Course Code	Course Name
VI	HMIT01T	Foundation of UI/UX
VI	HMIT01P	Foundation of UI/UX Lab
VII	HMIT02T	UX Design, Evaluation and ARVR
VII	HMIT02P	UX Design, Evaluation and ARVR Lab
VIII	HMIT03T	Use cases in UI/UX
VIII	HMIT03P	Use cases in UI/UX Lab

**2. Blockchain**

Semester	Course Code	Course Name
VI	HMIT04T	Blockchain Technology
VI	HMIT04P	Blockchain Technology Lab
VII	HMIT05T	Smart Contract and Crypto Currencies
VII	HMIT05P	Smart Contract and Crypto Currencies Lab
VIII	HMIT06T	Decentralize & Blockchain Technologies
VIII	HMIT06P	Decentralize & Blockchain Technologies Lab

**3. Next-Gen Artificial Intelligence and Machine Learning**

Semester	Course Code	Course Name
VI	HMIT07T	Ethics in AI
VI	HMIT07P	Ethics in AI Lab
VII	HMIT08T	Scalable ML and BDA
VII	HMIT08P	Scalable ML and BDA Lab
VIII	HMIT09T	Generative AI models
VIII	HMIT09P	Generative AI models Lab

**4. Next-Gen Data Science**

Semester	Course Code	Course Name
VI	HMIT10T	Data Visualization Using R-Programming
VI	HMIT10P	Data Visualization Using R-Programming Lab
VII	HMIT11T	Time Series and Forecasting

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Semester	Course Code	Course Name
VII	HMIT11P	Time Series and Forecasting Lab
VIII	HMIT12T	Data Ethics and Privacy
VIII	HMIT12P	Data Ethics and Privacy Lab

### 5. Next-Gen Cyber Security

Semester	Course Code	Course Name
VI	HMIT13T	IT Security Strategic Planning, Policy, and Leadership
VI	HMIT13P	IT Security Strategic Planning, Policy, and Leadership Lab
VII	HMIT14T	Advance Threat Intelligence and Penetration Testing
VII	HMIT14P	Advance Threat Intelligence and Penetration Testing Lab
VIII	HMIT15T	Advanced Computer Forensics Analysis
VIII	HMIT15P	Advanced Computer Forensics Analysis Lab

### 6. Next-Gen Internet of Things

Semester	Course Code	Course Name
VI	HMET01T*	Embedded Linux System
VI	HMET01P*	Embedded Linux System Lab
VII	HMET02T*	IoT & Data Analytics
VII	HMET02P*	IoT & Data Analytics Lab
VIII	HMET03T*	IoT Applications & Web Development
VIII	HMET03P*	IoT Applications & Web Development Lab

\* Detailed Syllabus of these courses can be obtained from the Honours/ Minor document of Electronics and Telecommunication department.

Learners of Information Technology Department who wish to opt for Minor Degree Programme offered by other department can obtain details of the same from Section-B and Section C of the Honour/ Minor Degree Programme document of respective department.

**[C] Honours/ Minor Degree Programmes Course Syllabus**

**Course Name:** Foundation of UI/UX

**Course Code:** HMIT01T

**Category:** Honours / Minor in UI/UX

**Preamble:**

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make everyday interactions usable.

**Pre-requisites:** Nil

**Course Objectives:**

1. To stress the importance of User Interface and User Experience.
2. To Learn User Experience Process.
3. To understand how to design Effective and Efficient User Interfaces for intended users.
4. To Learn user research techniques
5. To create personas
6. To understand UX guidelines

**Course Outcomes:**

CO1: Understand the importance of user interface and User Experience.

CO2: Learn user experience process

CO3: Understand how to design Effective and Efficient User Interfaces for intended users.

CO4: Learn user research techniques.

CO5: Create personas.

CO6: Understand UX guidelines.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the

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above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Sr. No.	Module	Detailed Content	Hrs	CO Mapping
0	Prerequisite	Web Technologies, Software Engineering Process	03	-
1	Introduction	What is UX, Ubiquitous interaction, Emerging desire for usability, From usability to user experience, Emotional impact as part of the user experience, User experience needs a business case, Roots of usability.	06	CO1
2	The Wheel: A Lifecycle Template	Introduction, A UX process lifecycle template, Choosing a process instance for your project, The system complexity space, Meet the user interface team, Scope of UX presence within the team, More about UX lifecycles.	06	CO2
3	Contextual Inquiry: Eliciting Work Activity Data	Introduction, User research, User work activity gathering, Look for emotional aspects of work practice, Abridged contextual inquiry process, Data-driven vs. model-driven inquiry, History, Contextual Analysis, Extracting Interaction Design Requirements, Constructing Design-Information Models.	10	CO3
4	Design Thinking, Ideation, and Sketching,	Introduction, Design paradigms, Design thinking, Design perspectives, User personas, Ideation, Sketching, More about phenomenology, Mental Models and Conceptual Design, Wireframe, Prototyping	10	CO4
5	Wireframes and Prototyping	Introduction to wireframes, types of wireframes, prototyping, types of prototyping	08	CO5
6	UX Design Guidelines	Introduction, Using and interpreting design guidelines, Human memory limitations, Selected UX design guidelines and examples, Planning, Translation, Physical actions, Outcomes, Assessment, Overall.	05	CO6

**Online resources**

<https://nptel.ac.in/courses/107/103/107103083/>

<https://www.uxbeginner.com/ux-courses/>

**Course Name:** Foundation of UI/UX Lab

**Course Code:** HMIT01P

**Category:** Honours/ Minor in UI/UX

**Preamble:**

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make those everyday interactions usable.

**Pre-requisites:** Nil

**Course Objectives:**

1. To stress the importance of User Interface and User Experience.
2. To Learn User Experience Process.
3. To understand how to design Effective and Efficient User Interfaces for intended users.
4. To Learn user research techniques
5. To create personas
6. To understand UX guidelines

**Course Outcomes:**

- CO1: Understand the importance of user interface and User Experience.  
CO2: Learn user experience process  
CO3: Understand how to design Effective and Efficient User Interfaces for intended users.  
CO4: Learn user research techniques.  
CO5: Create personas.  
CO6: Understand UX guidelines.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	25	25

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested Experiments:**

- Perform user research
- User requirement collection
- User Requirement Analysis
- Create User personas, user scenarios , customer journey maps etc
- Create Wireframes
- Create Prototypes
- Set UX Goals
- Any two case studies or mini project covering the above syllabus

**Books and References:**

**A. Books:**

1. The UX Book by Rex Hartson and Pardha Pyla
2. Smashing UX Design by Jesmond Allen and James Chudley
3. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
4. Don't Make Me Think, Revisited by Steve Krug
5. The User Experience Team of One by Leah Buley
6. The Elements of User Experience by Jesse James Garrett
7. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

**B. References:**

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
4. Human Computer Interaction by Alan Dix

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**Course Name:** UX Design, Evaluation and AR-VR

**Course Code:** HMIT02T

**Category:** Honour – Minor (UI/UX)

**Preamble:**

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make those everyday interactions usable.

**Pre-requisites:**

- Foundations of UI /UX
- Web Technologies
- Basic knowledge of designing tools and languages like HTML,

**Course Objectives:**

- Stress the importance of User Interface and User Experience.
- Evaluate designs based on usability and accessibility metrics.
- Explore the fundamentals of AR and VR technologies.
- Apply UX principles to create immersive AR/VR applications.
- Analyze real-world case studies to bridge theory with practice.

**Course Outcomes:**

Learner will be able to

- CO1 : Understand UX Design and learn UX process .
- CO2: Apply UX Evaluation and Testing
- CO3 : Understand the fundamentals of AR and VR technologies.
- CO4 : Learn Design principles of AR-VR
- CO5 : Create AR/VR system components and their applications.
- CO6 : Understand Ethics and Trends in UX and AR-V

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

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**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Sr. No.	Module	Detailed Content	Hrs	CO Mapping
1	<b>Introduction to UX Design</b>	<ul style="list-style-type: none"> <li>Principles of UX Design: Usability, Accessibility, and Interaction Design.</li> <li>UX vs. UI: Differences and overlaps.</li> <li>Design Thinking Process: Empathize, Define, Ideate, Prototype, and Test.</li> <li>Tools for UX Design: Figma, Adobe XD, Sketch.</li> </ul>	05	CO1
2	<b>UX Evaluation and Testing</b>	<ul style="list-style-type: none"> <li>Importance of Usability Testing: Metrics and Methods.</li> <li>Heuristic Evaluation and Cognitive Walkthroughs.</li> <li>User Testing Techniques: A/B Testing, Surveys, Focus Groups.</li> <li>Data Analysis in UX: Using heatmaps, analytics, and feedback.</li> <li>Hands-on: Conduct usability testing for a simple app prototype.</li> </ul>	05	CO2

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3	<b>Fundamentals of AR and VR</b>	<ul style="list-style-type: none"> <li>• Overview of Augmented Reality and Virtual Reality.</li> <li>• Key Components: Hardware (e.g., headsets, controllers), Software, and Sensors.</li> <li>• Differences Between AR and VR: Use cases and applications.</li> <li>• Introduction to AR SDKs (e.g., ARKit, ARCore) and VR platforms (e.g., Oculus, Unity).</li> </ul>	05	CO3
4	<b>AR and VR Design Principles</b>	<ul style="list-style-type: none"> <li>• UX for Immersive Technologies: Interaction design in 3D spaces.</li> <li>• Storyboarding and Prototyping for AR/VR.</li> <li>• Challenges: Motion sickness, haptics, and real-time performance.</li> <li>• Hands-on: Build a basic AR app using ARCore/ARKit.</li> </ul>	05	CO4
5	<b>Applications and Case Studies in AR/VR</b>	<ul style="list-style-type: none"> <li>• Applications in Engineering: Training simulations, product design, and prototyping.</li> <li>• Healthcare: Surgical simulations and patient education.</li> <li>• Education and Gaming: AR/VR for immersive learning.</li> <li>• Case Studies: Real-world success stories of AR/VR implementation.</li> </ul>	05	CO5
6	<b>Ethics and Future Trends in UX and AR/VR</b>	<ul style="list-style-type: none"> <li>• Ethical Design: Privacy, inclusivity, and psychological impacts.</li> <li>• Evaluating AR/VR for accessibility.</li> </ul>	05	CO6

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		<ul style="list-style-type: none"><li>• Future Directions: Mixed Reality, AI- driven AR/VR experiences.</li><li>• Final Project: Design and present an AR/VR application prototype.</li></ul>		
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**Online resources**

- <https://nptel.ac.in/courses/107/103/107103083/>
- <https://www.uxbeginner.com/ux-courses/>
- [Google UX Design Certificate](#)
- [Coursera AR/VR Development](#)

**Books and References:**

**A. Books:**

1. The Design of Everyday Things by Don Norman.
2. UX for XR: User Experience Design and Strategies for Immersive Technologies by Cornel Hillmann.
3. The UX Book by Rex Hartson and Pardha Pyla
4. Smashing UX Design by Jesmond Allen and James Chudley
5. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
6. Don't Make Me Think, Revisited by Steve Krug
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**B. References:**

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
4. Human Computer Interaction by Alan Dix

**C. Tools:**

1. Figma, Adobe XD, Sketch for UX.
2. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

**Course Name:** UX Design, Evaluation and AR-VR Lab

**Course Code:** HMIT02P

**Category:** Honour – Minor (UI/UX)

**Preamble:**

Usability engineering is a framework for evaluating digital products or services that focuses on the optimization of usability. It incorporates theories from both psychology and computer science. It involves an iterative approach to design by considering the needs, abilities, or even limitations of the intended users. UX designers focus on the interactions that people have with products like websites, mobile apps, and physical objects. UX designers make those everyday interactions usable.

**Pre-requisites:**

- Foundations of UI /UX ,
- Web Technologies
- Basic knowledge of designing tools and languages like HTML

**Lab Objectives:**

- Understand and Apply Design Thinking and UX Process
- Develop Skills in UX Evaluation and Testing
- Introduce Fundamentals of AR and VR Development
- Develop skills to design user-friendly and accessible AR/VR systems.
- Explore Ethical and Emerging Trends in UX and AR/VR

**Lab Outcomes:**

Learner will be able to

LO1: Apply the design thinking methodology and UX process.

LO2: Perform heuristic evaluations and usability testing for an existing application, documenting usability issues and proposing solutions.

LO3: Create a basic AR application or VR simulation using tools like Unity or ARKit, demonstrating understanding of fundamental technologies.

LO4: Build an interactive AR/VR experience

LO5: Present a research-based analysis on the ethical challenges and emerging trends in UX and AR/VR technologies

**Course Scheme:**

Contact Hours		Credits Assigned	
Practical	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	-	25

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her

course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

## **Suggested Experiments**

### **Experiment 1: Design Thinking Process**

**Objective:** Apply the Design Thinking methodology to solve a real-world problem.

**Tasks:**

- Identify a user problem (e.g., app for booking study rooms).
- Develop personas and empathy maps.
- Create low-fidelity prototypes using tools like Figma or paper sketches.

### **Experiment 2: Heuristic Evaluation**

**Objective:** Conduct heuristic evaluation for an existing website or app.

**Tasks:**

- Evaluate based on Jakob Nielsen's 10 Usability Heuristics.
- Document usability issues and severity ratings.
- Suggest design improvements.

### **Experiment 3: Usability Testing**

**Objective:** Test the usability of a simple app prototype.

**Tasks:**

- Define test tasks (e.g., logging in, completing a purchase). Recruit participants and record observations.
- Analyze results using usability metrics (e.g., task success rate).

### **Experiment 4: Accessibility Testing**

**Objective:** Evaluate a web application for accessibility compliance.

**Tasks:**

- Use tools like Axe or Lighthouse for automated testing.
- Manually inspect for color contrast, keyboard navigation, and screen reader compatibility.
- Propose fixes for identified issues.

### **Experiment 5: A/B Testing**

**Objective:** Perform A/B testing for UI variants.

**Tasks:**

- Create two design variants of a landing page.
- Simulate user interaction data using tools like Optimizely.
- Compare performance metrics (e.g., click-through rate, conversion rate).

### **Experiment 6: Building a Basic AR Application**

**Objective:** Develop an AR app for visualizing 3D models.

**Tasks:**

- Use ARCore or ARKit to create an app.
- Load and display a 3D object (e.g., furniture or car model) in a real-world environment.
- Test on a mobile device.

### **Experiment 7: Developing a VR Environment**

**Objective:** Create an interactive VR environment.

**Tasks:**

- Use Unity3D or Unreal Engine to design a virtual space.
- Add basic interaction, like picking up objects or moving in the environment.
- Test using a VR headset (e.g., Oculus or HTC Vive).

### **Experiment 8: Marker-Based AR**

**Objective:** Implement marker-based AR for object recognition.

**Tasks:**

- Use Vuforia or a similar SDK to detect markers (e.g., QR codes). Overlay relevant 3D models or information on detected markers. Optimize for accuracy and performance.

### **Experiment 9: Gesture-Based Interaction in VR**

**Objective:** Implement gesture recognition for VR navigation.

**Tasks:**

- Use Leap Motion or a similar device for tracking hand movements.
- Map gestures to interactions (e.g., swipe to open menus, pinch to zoom). Test the usability of the gesture system.

### **Experiment 10: Simulating Real-World Scenarios in VR**

**Objective:** Create a VR simulation for a real-world task.

**Tasks:**

- Develop a training module (e.g., assembling machinery). Include step-by-step guidance and feedback.
- Assess user learning outcomes based on interactions.

### **Online Resources:**

- <https://nptel.ac.in/courses/107/103/107103083/>
- <https://www.uxbeginner.com/ux-courses/>
- [Google UX Design Certificate](#)
- [Coursera AR/VR Development](#)

### **Books and References:**

**B. Books:**

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3. The UX Book by Rex Hartson and Pardha Pyla
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6. Don't Make Me Think, Revisited by Steve Krug
7. The User Experience Team of One by Leah Buley
8. The Elements of User Experience by Jesse James Garrett
9. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh

**B. References:**

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
4. Human Computer Interaction by Alan Dix

**C. Tools:**

1. Figma, Adobe XD, Sketch for UX.
2. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

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**Course Name:** USECASE in UI/UX

**Course Code:** HMIT03T

**Category:** Honour – Minor (UI/UX)

**Pre-requisites:**

- Foundations of UI /UX
- Design and evaluation with AR/VR applications and web sites
- Basic knowledge of designing tools and languages like HTML

**Course Objectives:**

- Identify problem statement.
- Create project document.
- Plan and conduct user research
- Design wireframes.
- Develop prototypes.
- Perform testing and evaluation.

**Course Outcomes:**

Learner will be able to

- CO1: Identify problem statement from any domain.
- CO2: Create and Complete project document.
- CO3: Understand the process of user research and apply.
- CO4: Design wireframes
- CO5: Develop low fidelity and high fidelity prototypes
- CO6: Evaluate and Test USECASE.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	75	-	-	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

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Sr. No.	Module	Detailed Content	Hrs	CO Mapping
1	<b>Problem Identification</b>	<p>Select a real-world problem relevant to your chosen domain.</p> <ol style="list-style-type: none"> <li>a. UI/UX Example: Redesign a website or app for improved accessibility and usability.</li> <li>b. AR-VR Example: Develop a VR training module for assembly line workers or an AR-based educational app.</li> </ol>	05	CO1
2	<b>Project Proposal</b>	<p>Create a <b>proposal document</b> with the following components:</p> <ol style="list-style-type: none"> <li>1. <b>Title:</b> A concise project title.</li> <li>2. <b>Background:</b> Context of the problem and why it's significant.</li> <li>3. <b>Objectives:</b> What the project aims to achieve.</li> <li>4. <b>Scope:</b> Define the boundaries of the project.</li> <li>5. <b>Methodology:</b> <ul style="list-style-type: none"> <li>▪ UI/UX: Design Thinking or Agile UX methodology.</li> <li>▪ AR-VR: Software development lifecycle (SDLC) specific to AR/VR.</li> </ul> </li> </ol>	05	CO2
3	<b>Planning and Research</b>	<p>Conduct user research:</p> <ol style="list-style-type: none"> <li>a. UI/UX: Surveys, interviews, usability tests.</li> <li>b. AR-VR: Use case analysis, technical feasibility study.</li> </ol> <p>Benchmark similar applications and identify gaps.</p>	05	CO3
4	<b>Design and Prototyping</b>	<p><b>UI/UX Projects:</b></p> <ol style="list-style-type: none"> <li>a. Use tools like <b>Figma</b>, <b>Adobe XD</b>, or <b>Sketch</b> for prototyping.</li> </ol>	05	CO4

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		<p>b. Prepare:</p> <ul style="list-style-type: none"> <li>i. Wireframes (low- fidelity and high-fidelity).</li> <li>ii. User flows and interaction designs.</li> </ul> <p>Include accessibility considerations (e.g., color contrast, keyboard navigation).</p>		
<b>5</b>	<b>Development</b>	<p><b>UI/UX:</b></p> <ul style="list-style-type: none"> <li>a. Develop functional prototypes or implement designs in a working product (e.g., using HTML/CSS/JavaScript).</li> <li>b. Integrate usability testing during the development phase.</li> </ul> <p><b>AR-VR:</b></p> <ul style="list-style-type: none"> <li>c. Develop AR/VR applications using SDKs (e.g., Vuforia for AR, Oculus SDK for VR).</li> <li>d. Optimize for performance and interactivity.</li> </ul>	05	CO5
<b>6</b>	<b>Testing and Evaluation</b>	<p><b>UI/UX:</b></p> <ul style="list-style-type: none"> <li>a. Conduct usability tests: <ul style="list-style-type: none"> <li>i. Recruit participants matching your target audience.</li> <li>ii. Use metrics like task success rate, error rate, and time-on-task.</li> </ul> </li> </ul> <p><b>AR-VR:</b></p> <ul style="list-style-type: none"> <li>b. Evaluate: <ul style="list-style-type: none"> <li>i. Immersion: How engaging is the experience?</li> <li>ii. Performance: Frame rates, responsiveness</li> </ul> </li> </ul>	05	CO6

**Books and References:**

**A. Books:**

1. The Design of Everyday Things by Don Norman.
2. UX for XR: User Experience Design and Strategies for Immersive Technologies by Cornel Hillmann.
3. The UX Book by Rex Hartson and Pardha Pyla
4. Smashing UX Design by Jesmond Allen and James Chudley
5. Lean UX: Applying Lean Principles to Improve User Experience by Jeff Gothelf and Josh Seiden
6. Don't Make Me Think, Revisited by Steve Krug

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7. The User Experience Team of One by Leah Buley
8. The Elements of User Experience by Jesse James Garrett
9. Sketching User Experiences: The Workbook by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt and Bill Buxton

**B. References:**

1. A Project Guide to UX Design by Russ Unger and Carolyn Chandler
2. Agile Experience Design by Lindsay Ratcliffe and Marc McNeill
3. Universal Principles of Design by William Lidwell, Kritina Holden and Jill Butler
4. Human Computer Interaction by Alan Dix

**C. Tools:**

1. Figma, Adobe XD, Sketch for UX.
2. Unity3D, Unreal Engine, ARKit, ARCore for AR/VR.

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**Course Name:** USECASE in UI/UX Lab

**Course Code:** HMIT03P

**Category:** Honour – Minor (UI/UX)

**Pre-requisites:**

- Foundations of UI /UX
- Design and evaluation with AR/VR applications and web sites.
- Basic knowledge of designing tools and languages like HTML, Figma.

**Lab Objectives:**

- Identify problem statement.
- Create project document.
- Plan and conduct user research
- Design wireframes.
- Develop prototypes.
- Perform testing and evaluation.

**Lab Outcomes:**

Learner will be able to

- LO1 : Identify problem statement from any domain.
- LO2 : Create and Complete project document.
- LO3 : Understand the process of user research and apply.
- LO4 : Design wireframes
- LO5 : Develop low fidelity and high-fidelity prototypes
- LO6 : Evaluate and Test USECASE.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

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The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-		50

**Guidelines for USECASE Documentation and Presentation**

<b>A</b>	<b>Documentation and Presentation</b>	<p>Create a final <b>report</b> including:</p> <ol style="list-style-type: none"> <li>1. Introduction and objectives.</li> <li>2. Literature review.</li> <li>3. Methodology.</li> <li>4. Design and development process.</li> <li>5. Testing and results.</li> <li>6. Future scope and limitations.</li> </ol> <p>Prepare a <b>presentation</b>:</p> <ul style="list-style-type: none"> <li>• Showcase project workflow, results, and demonstrations.</li> <li>• Use visuals like videos or live demos for AR/VR projects.</li> </ul>
<b>B</b>	<b>Suggested Project Topics</b>	<p><b>UI/UX Topics:</b></p> <ol style="list-style-type: none"> <li>a. Redesign a government service portal for better usability.</li> <li>b. Build an accessible e-learning platform for visually impaired users.</li> <li>c. Create a mobile app for mental health tracking with gamification elements.</li> </ol> <p><b>AR-VR Topics:</b></p> <ol style="list-style-type: none"> <li>a. VR-based firefighter training simulator.</li> <li>b. AR app for interior design visualization. VR museum tour with interactive 3D exhibits</li> </ol>

**Resources**

- **UI/UX Tools:** Figma, Adobe XD, Sketch, Axure.
- **AR-VR Tools:** Unity3D, Unreal Engine, ARKit, ARCore.
- **Hardware:** AR-capable phones, VR headsets (Oculus, HTC Vive).
- **Research Material:** Google UX Design Certificate, Unity Learn AR/VR tutorials

**Evaluation Criteria**

- **Relevance and Innovation** (10M): How well does the project address the problem?
- **Design Quality** (15M): Quality of design and adherence to usability/interaction principles.
- **Technical Implementation** (30M): Functionality and technical robustness.
- **Testing and Evaluation** (10M): Depth of testing and insights from results.
- **Presentation** (10M): Clarity and effectiveness of documentation and demonstration.

**Course Name:** Blockchain Technology

**Course Code:** HMIT04T

**Category:** Honours/ Minors in Blockchain

**Preamble:**

Blockchain Technology course provides students with a comprehensive understanding of blockchain fundamentals, decentralized systems, and their applications. Through lectures, case studies, and hands-on exercises, students will learn about the underlying principles of blockchain technology, its evolution, and its potential impact on various industries. Topics covered include distributed ledger technology, consensus mechanisms, smart contracts, cryptocurrencies, and real-world use cases.

**Pre-requisites:** Computer Network

**Course Objectives:**

1. To understand conceptual elements for Blockchain Technologies.
2. To summarize the major developments related to Blockchain and cryptocurrencies.
3. To identify real-world applications of Blockchain.

**Course Outcomes:**

Learner will be able to:

CO1: Identify the importance of Blockchain technology

CO2: Interpret the fundamentals and basic concepts in Blockchain

CO3: Summarize the requirements of the basic design of blockchain.

CO4: Compare the working of different blockchain platforms

CO5: Summarize the different technologies and latest trends in Blockchain

CO6: Analyze the importance of blockchain in finding the solution to the real-world problems.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Blockchain Technology	Basic ideas behind block chain, how it is changing the landscape of digitalization, introduction to cryptographic concepts, hashing, public key cryptosystems, private vs public block chain and use cases, Hash Puzzles.	5
2	Blockchain Fundamentals	Basic architecture of Blockchain, different terminologies, Characteristics of Block chain, Types of networks, Introducing Smart contract concept in Blockchain.	5
3	Components of Blockchain	Core components of Blockchain, Types of blockchains, blockchain protocol, and Permission & Permission less Block chains.	5
4	Digital Ledger	Short History of Money and Trust, Bitcoin Mechanics, Introduction to Ethereum, Introduction to Hyperledger, Hyperledger Fabric and its architecture, Hyperledger Composer	5
5	Emerging Trends in Blockchain:	Cloud-based blockchain, Multi chain, Geth, Stellar, Ripple, R3 Corda, Blockchain API, Blockchain Sandboxes	5
6	Block Chain Use Cases	Supply Chain Management, Finance, Health Care, Internet of Things (IoT), Remittance, Land Records, Voting and election, Loyalty Programs, GoGreen (Renewable Energy).	5
<b>Total</b>			<b>30</b>

**Textbooks:**

1. Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Crypto currency".
2. Scott Marks, "Blockchain for Beginners: Guide to Understanding the Foundation and Basics of the Revolutionary Blockchain Technology", Create Space Independent Publishing Platform

**Reference Books:**

1. Mark Watney, "Blockchain for Beginners".
2. Alwyn Bishop, "Blockchain Technology Explained".

**E-sources:**

1. NPTEL Course "**Introduction to Blockchain Technology & Applications**"  
<https://nptel.ac.in/courses/106/104/106104220/>
2. NPTEL Course on "**Blockchain Architecture & UseCases**"  
<https://nptel.ac.in/courses/106/105/106105184/>

**Course Name:** Blockchain Technology Lab

**Course Code:** HMIT04P

**Category:** Honours/Minors in Blockchain

**Pre-requisites:** NIL

**Course Objectives:**

After completion of the course, students will have adequate background, conceptual clarity, and knowledge related to:

1. The working of blockchain technology
2. The real-world applications of Blockchain.

**Course Outcomes:**

Students who complete this course successfully are expected to:

- CO 1. Understand working of Blockchain.
- CO 2. Creating Cryptographic hash using a Merkle tree.
- CO 3. Understand data protection using Blockchain.
- CO 4. Understand the cryptographic basis for cryptocurrency.
- CO 5. Creating genesis block using open source tool.
- CO6. Choose a blockchain implementation based on real time scenario

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested list of experiments:**

Sr. No.	List of experiments
1	Case Study on various Blockchain platforms.

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<b>Sr. No.</b>	<b>List of experiments</b>
2	Cryptography in Blockchain, Merkle root tree has
3	Two Factor Authentication using blockchain
4	Blockchain based application Crypto Exchange and Wallet.
5	Create the genesis block using Puppeth, a CLI tool.
6	Implement simple Smart Contracts in Remix IDE

**Textbooks:**

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects by Elad Elrom.
2. Practical Blockchains and Cryptocurrencies by Karan Singh Garewal

**Reference Books:**

1. The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects by Elad Elrom
2. Building Blockchain Projects by Prusty Narayan
3. Building Blockchain Apps| 1st Edition| By Pearson by, Michael Juntao Yuan

**Course Name:** Decentralize & Blockchain Technologies

**Course Code:** HMIT06T

**Category:** Honours /Minor

**Pre-requisites:**

Computer Networks

Cryptography & Network Security

Data Structures

Distributed Systems

**Course Objectives:**

After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

1. To understand the foundations of decentralized systems and peer-to-peer networks.
2. To explore the architecture and mechanisms of blockchain technology.
3. To study consensus mechanisms and smart contract development.
4. To investigate blockchain use-cases across various industries.
5. To analyze the challenges, security issues, and future directions of decentralized technologies.

**Course Outcomes:**

Learner will be able to:

Students who complete this course successfully are expected to:

CO1: Explain the fundamentals of decentralized networks and blockchain architecture.

CO2: Analyze various consensus mechanisms and their applicability.

CO3: Describe and evaluate blockchain platforms and smart contracts.

CO4: Apply blockchain concepts to design use-case-driven solutions.

CO5: Understand regulatory, scalability, and security issues in blockchain.

CO6: Critically assess future trends and developments in decentralized technologies.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	15	20	40	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised

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assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Module No.	Module Name	Content	No of Hours
1	Introduction to Decentralization & Blockchain	Centralized vs decentralized systems, peer-to-peer networks, history and evolution of blockchain, key components: blocks, nodes, ledgers, hash, nonce, Merkle trees	5
2	Blockchain Architecture & Mechanics	Blockchain structure, public vs private vs consortium blockchain, cryptographic primitives (SHA-256, digital signatures), distributed consensus	5
3	Consensus Mechanisms	Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS, Practical Byzantine Fault Tolerance (PBFT), Proof of Authority (PoA), comparisons and use-cases	5
4	Smart Contracts & Platforms	Ethereum overview, smart contract architecture, Solidity basics, use of EVM, Hyperledger Fabric, blockchain as a service (BaaS)	5
5	Applications of Blockchain	Blockchain in finance, supply chain, healthcare, voting, identity management, NFTs and tokenization, enterprise use-cases	5
6	Challenges, Security & Future Directions	Scalability (sharding, Layer 2), security vulnerabilities (51% attack, reentrancy, Sybil), privacy-enhancing tech (ZKP, mixers), regulatory concerns, CBDCs, Web3	5
<b>Total</b>			<b>30</b>

**Textbooks:**

1. Melanie Swan, Blockchain: Blueprint for a New Economy, O'Reilly Media, 2015.
2. Andreas M. Antonopoulos, Mastering Bitcoin, O'Reilly Media, 2nd Edition, 2017.
3. Imran Bashir, Mastering Blockchain, Packt Publishing, 4th Edition, 2023.

**Reference Books:**

1. Arvind Narayanan et al., Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016.
2. Joseph Bonneau et al., SoK: Research Perspectives and Challenges for Blockchain Technology, IEEE, 2015.
3. Ethereum White Paper: <https://ethereum.org/en/whitepaper/>
4. Hyperledger Fabric Documentation: <https://hyperledger-fabric.readthedocs.io>
5. MIT OpenCourseWare: Blockchain and Money – <https://ocw.mit.edu>

**Course Name:** Decentralized & Blockchain Technologies Lab

**Course Code:** HMIT06P

**Category:** Honour/Minor

**Preamble:**

The course aims to offer hands-on experience with decentralized systems and blockchain technologies, focusing on development and deployment of smart contracts, simulation of consensus protocols, and real-world blockchain applications. It equips students with essential technical skills to understand and implement blockchain-based solutions.

**Pre-requisites:**

- Computer Programming (Python/JavaScript)
- Computer Network
- Cryptography and Network Security
- Basic Web Development

**Course Objectives:**

After completion of the course, students will have adequate background, conceptual clarity and knowledge related to:

- To provide practical experience with blockchain architecture and peer-to-peer networks.
- To develop and deploy smart contracts using blockchain platforms such as Ethereum.
- To simulate consensus algorithms and cryptographic techniques used in blockchain.
- To design and implement simple decentralized applications (dApps).

**Course Outcomes:**

Students who complete this course successfully are expected to:

CO 1: Demonstrate understanding of blockchain architecture and setup using Ethereum.

CO 2: Implement smart contracts using Solidity and deploy them on test networks.

CO 3: Simulate consensus algorithms and analyze their effectiveness.

CO 4: Apply blockchain concepts to develop dApps for real-world scenarios.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment Guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment methodology may be adapted by faculty and approved at the institute level prior to semester commencement.

**Suggested List of Experiments:**

Sr. No.	List of Experiments
1	Set up Ethereum environment (MetaMask, Ganache, Truffle). Deploy and test simple transactions.
2	Create a basic blockchain using Python or JavaScript with block validation logic.
3	Write and deploy a basic smart contract using Solidity on Remix IDE.
4	Interact with smart contracts via Web3.js and testnet (e.g., Ropsten/Goerli).
5	Develop and simulate a simple voting dApp using smart contracts.
6	Design and deploy an ERC-20 token smart contract
7	Simulate Proof of Work consensus using Python (basic mining simulation).
8	Create a private blockchain using Ganache and simulate peer nodes and transactions.
9	Demonstrate hashing and digital signatures using Python/OpenSSL.
10	Mini Project: Blockchain-based use-case implementation (e.g., asset tracking, certificate issuance).

**Textbooks:**

1. Mastering Blockchain, Imran Bashir, Packt Publishing, 4th Edition, 2023.
2. Mastering Ethereum, Andreas M. Antonopoulos & Gavin Wood, O'Reilly Media, 2018.

**Reference Books:**

1. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan et al., Princeton University Press, 2016.
2. Ethereum White Paper – <https://ethereum.org/en/whitepaper>
3. Hyperledger Fabric Documentation – <https://hyperledger-fabric.readthedocs.io>
4. Remix Solidity IDE – <https://remix.ethereum.org>

**Course Name:** Ethics in AI

**Course Code:** HMIT07T

**Category:** Honors in Next-Gen AI&ML

**Preamble:**

The rapid advancement of Artificial Intelligence (AI) and Machine Learning (ML) has revolutionized numerous industries and daily life, introducing unprecedented opportunities and challenges. As these technologies integrate deeply into societal structures, it becomes imperative to consider their ethical, social, and environmental implications. This course aims to provide learners with a foundational understanding of ethical principles and frameworks as applied to AI/ML systems.

**Pre-requisites:**

Artificial Intelligence, Machine Learning

**Course Objectives:**

- Understand ethical considerations in AI and ML development and deployment.
- Explore frameworks for ethical decision-making in AI systems.
- Assess potential biases, privacy issues, and impacts of AI on society.
- Learn legal and policy implications related to AI and ML.
- Develop skills to implement ethical practices in AI projects.
- Foster critical thinking to address ethical challenges in real-world scenarios.

**Course Outcomes:**

Learner will be able to:

1. Demonstrate understanding of ethical principles in AI/ML.
2. Identify and mitigate bias and fairness issues in datasets and algorithms.
3. Apply ethical frameworks to evaluate AI systems.
4. Design AI systems with accountability, transparency, and fairness.
5. Understand societal impacts
6. Engage in ethical decision-making during AI system development.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

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The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Ethics in AI/ML	Overview of Ethics: Moral principles, ethics vs. legality. Why Ethics in AI/ML? Risks and challenges. Key Ethical Issues in AI: Bias, fairness, accountability, transparency. Case Studies: Real-world AI ethical dilemmas.	5
2	Bias and Fairness in AI/ML	Definition and Types of Bias in AI: Dataset bias, algorithmic bias. Techniques to Detect and Mitigate Bias in ML Models. Fairness Frameworks: Disparate impact, equalized odds. Ethical Data Collection and Preprocessing.	5
3	Privacy and Security Concerns	Privacy Challenges in AI: Data collection, storage, and sharing. Ethical Guidelines for User Data Protection. Security Risks in AI Systems: Deepfakes, adversarial attacks. GDPR and Other Privacy Regulations.	5
4	Accountability and Transparency	Need for Explainable AI (XAI). Strategies for Creating Transparent AI Systems. Accountability in AI Decision-Making. Ethical Implications of Autonomous Systems.	5
5	Societal Impacts of AI/ML	Impacts on Employment and Workforce. AI and Social Inequality. Misinformation and AI-Generated Content. AI in Healthcare, Education, and Governance.	5
6	Legal and Ethical Frameworks in AI	Overview of AI Ethics Guidelines (IEEE, UNESCO, etc.). AI Laws and Policies: International and regional perspectives. Intellectual Property and AI-Generated Content. Future Directions in AI Ethics.	5
<b>Total</b>			<b>30</b>

**Textbooks:**

1. AI Ethics: A Textbook by Paula Boddington - A comprehensive introduction to ethical challenges in AI systems.
2. Atlas of AI by Kate Crawford - Discusses the societal and environmental impact of AI

**Reference Books:**

1. The Ethical Algorithm by Aaron Roth & Michael Kearns - Explores designing socially aware algorithms
2. Human Compatible by Stuart Russell - Focuses on aligning AI with human values
3. Moral Machines: Teaching Robots Right From Wrong by Wendell Wallach and Colin Allen - Examines embedding ethics into AI systems.

**Online Resources for Learning:**

1. **Responsible AI Toolkit Reading List** - A curated set of academic papers and books focusing on responsible AI development and ethics [Responsible AI Toolkit](#)
2. **Oxford Academic Journals** - Offers edited volumes on AI ethics and related fields, often authored by leading experts

**Course Name:** Ethics in AI Lab

**Course Code:** HMIT07P

**Category:** Honors in Next-Gen AI&ML

**Preamble:**

The rapid advancement of Artificial Intelligence (AI) and Machine Learning (ML) has revolutionized numerous industries and daily life, introducing unprecedented opportunities and challenges. As these technologies integrate deeply into societal structures, it becomes imperative to consider their ethical, social, and environmental implications. This lab manual is designed to equip learners with practical skills to address ethical concerns in AI and ML systems while fostering a deeper understanding of fairness, accountability, transparency, and privacy. Through guided experiments and critical discussions, students will explore the balance between technological innovation and ethical responsibility, preparing them to design and deploy AI systems that respect human values and promote societal good.

**Pre-requisites:**

Artificial Intelligence Lab, Machine Learning Lab

**Course Objectives:**

- Understand ethical considerations in AI and ML development and deployment.
- Explore frameworks for ethical decision-making in AI systems.
- Assess potential biases, privacy issues, and impacts of AI on society.
- Learn legal and policy implications related to AI and ML.
- Develop skills to implement ethical practices in AI projects.
- Foster critical thinking to address ethical challenges in real-world scenarios.

**Course Outcomes:**

Learner will be able to:

1. Demonstrate understanding of ethical principles in AI/ML.
2. Identify and mitigate bias and fairness issues in datasets and algorithms.
3. Apply ethical frameworks to evaluate AI systems.
4. Design AI systems with accountability, transparency, and fairness.
5. Understand societal impacts
6. Engage in ethical decision-making during AI system development.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested List of Practicals:**

1. Bias Detection and Mitigation in ML Models
2. Privacy Preservation Using Differential Privacy
3. Explainable AI (XAI): Interpreting Black-Box Models
4. Adversarial Attack and Defense Strategies
5. Fairness in AI-Powered Recommendation Systems
6. Simulating Ethical Dilemmas in Autonomous Systems
7. Energy Efficiency Analysis of ML Models
8. Ethical Concerns in NLP Models for Sentiment Analysis
9. Misinformation Detection Using AI
10. Guidelines for Ethical Data Collection and Labeling

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**Course Name:** Scalable ML and Big Data Analytics

**Course Code:** HMIT08T

**Category:** Honours/Minors

**Preamble:**

This course introduces students to scalable techniques in Machine Learning and Big Data Analytics, focusing on processing large-scale datasets using distributed frameworks like Apache Spark and Hadoop. It emphasizes the design, implementation, and optimization of machine learning and deep learning models in scalable environments.

**Pre-requisites:**

Data Structure & Analysis - IT01T

Machine Learning - IT15T

**Course Objectives:**

- Understand the fundamentals of big data, its architecture, and the need for scalable machine learning systems.
- Explore and implement scalable machine learning algorithms using distributed computing frameworks like Apache Spark and Hadoop.
- Apply deep learning techniques in distributed environments and analyze their performance on large-scale datasets.
- Design and evaluate end-to-end big data analytics pipelines, integrating real-time data processing and model deployment.

**Course Outcomes:**

Learner will be able to:

CO1: Explain the architecture and components of big data and scalable ML systems.

CO2: Use big data tools such as Hadoop, Spark, and Kafka for distributed data processing.

CO3: Implement and evaluate scalable ML algorithms using Spark MLlib or equivalent libraries.

CO4: Train and fine-tune deep learning models on large datasets using distributed training approaches.

CO5: Build and deploy real-time data analytics pipelines for practical applications.

CO6: Analyze and interpret the performance and limitations of scalable ML models using appropriate metrics and techniques.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Tutorial	Theory	Tutorial
2	--	2	--

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

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The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No.	Module name	Content	No. of Hours
1	Introduction to Big Data and Scalable Machine Learning	Overview of Big Data: Characteristics, sources, and challenges (Volume, Variety, Velocity, Veracity, Value) Traditional vs. Big Data approaches Introduction to Scalable ML: Need for scalability, distributed computing, ML pipeline in the context of big data Tools and frameworks overview: Hadoop, Spark, Flink, etc.	4
2	Big Data Storage and Processing Frameworks	Distributed File Systems: HDFS architecture, data replication, block storage Introduction to Hadoop Ecosystem: MapReduce paradigm Apache Spark: RDDs, DataFrames, DAGs In-memory computing and performance benefits Streaming and batch processing frameworks (Spark Streaming, Flink, Kafka basics)	6
3	Scalable Machine Learning Algorithms	Introduction to scalable ML libraries: MLlib, H2O.ai, TensorFlow on Spark Scalable versions of ML algorithms: Linear/Logistic Regression, Decision Trees and Random Forest, K-Means Clustering, Gradient Boosted Trees	6
4	Feature Engineering and Model Optimization at Scale	Handling high-dimensional data Feature selection, dimensionality reduction (e.g., PCA, t-SNE) Data preprocessing at scale (Spark DataFrames, pipelines) Hyperparameter tuning at scale (Grid Search, Random Search using MLlib/Hyperopt) Model evaluation and cross-validation in distributed environments	6
5	Deep Learning with Big Data	Introduction to Deep Learning at scale Distributed training techniques (data parallelism, parameter servers) Using TensorFlow, PyTorch with Spark and BigDL Case study: Image/Text classification using distributed DL frameworks Use of GPU clusters and cloud-based training (Google Colab, AWS SageMaker basics)	4
6	Applications, Case Studies & Emerging Trends	Real-world applications: Fraud detection, recommender systems, IoT analytics Case studies: Netflix, Uber, Amazon, etc.	4

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		Ethical issues in large-scale data analysis (bias, privacy, fairness) Edge computing and federated learning overview Trends: AutoML, MLOps, Large Language Models at scale	
<b>Total</b>			<b>30</b>

**Textbooks:**

1. Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, "Advanced Analytics with Spark: Patterns for Learning from Data at Scale", O'Reilly Media
2. Nick Pentreath, "Machine Learning with Spark", Packt Publishing
3. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", Cambridge University Press

**Reference Books:**

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, "Big Data: Principles and Paradigms", Morgan Kaufmann
2. Vijay Kotu, "Data Science for Engineers", Elsevier
3. Tomasz Drabas, Denny Lee, "Deep Learning with PyTorch and Spark", O'Reilly Media

**Course Name:** Scalable ML and Big Data Analytics Lab

**Course Code:** HMIT08P

**Category:** Honors/Minors

**Preamble:**

This course introduces students to scalable techniques in Machine Learning and Big Data Analytics, focusing on processing large-scale datasets using distributed frameworks like Apache Spark and Hadoop. It emphasizes the design, implementation, and optimization of machine learning and deep learning models in scalable environments.

**Pre-requisites:**

Data Structure & Analysis Lab - IT01P

Machine Learning Lab- IT15P

**Course Objectives:**

- Understand the fundamentals of big data, its architecture, and the need for scalable machine learning systems.
- Explore and implement scalable machine learning algorithms using distributed computing frameworks like Apache Spark and Hadoop.
- Apply deep learning techniques in distributed environments and analyze their performance on large-scale datasets.
- Design and evaluate end-to-end big data analytics pipelines, integrating real-time data processing and model deployment.

**Course Outcomes:**

Learner will be able to:

CO1: Explain the architecture and components of big data and scalable ML systems.

CO2: Use big data tools such as Hadoop, Spark, and Kafka for distributed data processing. CO3: Implement and evaluate scalable ML algorithms using Spark MLlib or equivalent libraries.

CO4: Train and fine-tune deep learning models on large datasets using distributed training approaches.

CO5: Build and deploy real-time data analytics pipelines for practical applications.

CO6: Analyze and interpret the performance and limitations of scalable ML models using appropriate metrics and techniques.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

**Suggested list of experiments:**

Sr. No.	List of experiments
1	Perform file operations on HDFS – uploading, reading, and deleting files.
2	Write a MapReduce program to count word frequency in a large text file.
3	Use Spark RDDs and DataFrames to perform transformations and actions on a large dataset
4	Apply Logistic Regression and Decision Trees using Spark MLlib on a classification dataset.
5	Cluster high-dimensional data using K-Means in Spark, visualize clusters using t-SNE/PCA.
6	Compare the performance of Random Forest and Gradient Boosting using large datasets.
7	Implement feature selection and normalization pipelines using Spark ML.
8	Build a simple deep learning model (e.g., MNIST classifier) using TensorFlow or PyTorch.
9	Integrate a deep learning model with Spark for inference on streaming or batch data.
10	Mini Project

**Textbooks:**

1. Sandy Ryza, Uri Laserson, Sean Owen, Josh Wills, "Advanced Analytics with Spark: Patterns for Learning from Data at Scale", O'Reilly Media
2. Nick Pentreath, "Machine Learning with Spark", Packt Publishing
3. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", Cambridge University Press

**Reference Books:**

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, "Big Data: Principles and Paradigms", Morgan Kaufmann
2. Vijay Kotu, "Data Science for Engineers", Elsevier
3. Tomasz Drabas, Denny Lee, "Deep Learning with PyTorch and Spark", O'Reilly Media

**Course Name:** Generative AI models

**Course Code:** HMIT09T

**Vertical/ Sub-Vertical:**

**K-S-A Mapping:** Knowledge & Skill

**Pre-requisite required:** IT21T (Artificial Intelligence), IT15T (Machine Learning)

**Pre-requisite for:** NIL

**Recommended Semester:** 8

**Course Scheme:**

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
HMIT09T	2	--	2	--
HMIT09P	--	2	--	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
HMIT09T	15	20	40	75
HMIT09P	25	-	25	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

**Preamble:**

Generative AI represents a dynamic field at the forefront of technological advancement, where algorithms are imbued with the capacity to imagine, create, and innovate. In this course, we aim to provide you with a comprehensive understanding of the principles, techniques, and applications of Generative AI, while offering you the opportunity to delve into specialized topics and hands-on projects tailored to your interests.

**Course Objectives:**

- Understand the mathematical foundations of generative models.
- Learn popular deep generative architectures such as GANs and VAEs.
- Explore real-world applications of generative AI.
- Develop and evaluate generative models using Python and deep learning libraries.

**Course Outcomes:**

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand the fundamental concepts of generative models and distinguish between discriminative and generative approaches	Understanding
CO2	Apply probabilistic concepts and latent variable models to interpret and construct generative frameworks like VAEs and GANs.	Applying
CO3	Develop and train Variational Autoencoders and analyze their effectiveness in generating high dimensional data.	Applying
CO4	Implement Generative Adversarial Networks and explore advanced architectures like DCGAN, cGAN, and StyleGAN.	Applying
CO5	Experiment with and evaluate transformer-based and diffusion-based generative models for tasks such as text generation and image synthesis.	Applying
CO6	Demonstrate practical skills in using industry tools (like Hugging Face, OpenAI API, Stable Diffusion) and create a mini-project applying generative AI to real-world problems.	Applying

**Detailed Syllabus:**

Module No.	Module name	Content	No. of Hours
1	Introduction to Generative Models and Gen AI	<p>What are Generative Models?</p> <p>Discriminative vs Generative Approaches</p> <p>History and Evolution of Generative AI</p> <p>Key Applications:</p> <ul style="list-style-type: none"> <li>Image generation (DALL·E, Midjourney)</li> <li>Text generation (ChatGPT, GPT-4)</li> <li>Code generation (Copilot, CodeGen)</li> <li>Music, Art, and Video synthesis</li> </ul> <p>Introduction to ethical and social concerns</p> <ul style="list-style-type: none"> <li>Deepfakes, hallucination, biases</li> </ul> <p>Overview of major models: GANs, VAEs, Diffusion Models, Transformers</p>	5
2	Probability & Mathematical Foundations	<p>Random Variables, Probability Distributions (Gaussian, Bernoulli, etc.)</p> <p>Maximum Likelihood Estimation (MLE)</p> <p>KL Divergence and Cross-Entropy</p> <p>Jensen's Inequality, Bayesian Inference: Priors, Posteriors</p> <p>Latent Variable Models</p> <p>Review of Autoencoders: Encoder, Decoder, Reconstruction</p> <p>Concept of Latent Space</p>	4
3	Variational Autoencoders (VAEs)	<p>Probabilistic Encoder/Decoder</p> <p>Reparameterization Trick</p> <p>Loss Function: Reconstruction + KL Divergence</p> <p>Sampling from Latent Space Applications in image denoising, style transfer</p>	5

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4	Generative Adversarial Networks (GANs)	<p>GAN Architecture: Generator vs Discriminator Adversarial Loss and Training Procedure Instabilities and Training Tricks</p> <ul style="list-style-type: none"> <li>Label smoothing, BatchNorm, Learning rates</li> </ul> <p>GAN Variants:</p> <ul style="list-style-type: none"> <li>DCGAN (Deep Convolutional GAN)</li> <li>Conditional GAN (cGAN)</li> <li>CycleGAN, StyleGAN</li> </ul> <p>Evaluation Metrics: FID, Inception Score</p>	6
	Diffusion Models & Transformer- based Gen AI	<p>Overview of Diffusion Models</p> <ul style="list-style-type: none"> <li>Forward and Reverse Process</li> <li>Sampling and Noise Scheduling</li> <li>Models: DDPM, Stable Diffusion</li> </ul> <p>Transformer Architectures:</p> <ul style="list-style-type: none"> <li>Encoder-Decoder, Self-Attention</li> <li>GPT-style Autoregressive Models</li> </ul> <p>Training Large Language Models (LLMs) Prompt Engineering Basics</p>	5
5	Tools, Projects, and Applications	<p><b>Contents:</b> Using Gen AI tools: Hugging Face, OpenAI, RunwayML, Replicate Design Thinking for GenAI projects Capstone Mini-Project Options:</p> <ul style="list-style-type: none"> <li>Story generator</li> <li>Chatbot</li> <li>AI artist or designer</li> </ul> <p>Educational tutor</p>	5
6		<ul style="list-style-type: none"> <li>Deployment basics (Streamlit/Gradio) Ethics and the Future of Generative AI</li> </ul>	
<b>Total</b>			<b>30</b>

Sr. No.	List of experiments
1	Visualizing Probability Distributions: Plot Gaussian, Bernoulli, and Multinomial distributions.
2	Build a Simple Autoencoder
3	Train a VAE on Fashion-MNIST
4	Train a DCGAN on MNIST or CIFAR-10
5	Conditional GAN for Digit Generation
6	Text-to-Image Generation with Stable Diffusion

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7	Generate Text using GPT-2 or GPT-Neo
8	Build an AI Art Generator or Chatbot
9	Face Aging or Style Transfer using GANs

**Course Name:** Data visualization using R Programming

**Course Code:** HMIT10T

**Category:** Honors in Next-Gen DS

**Preamble:**

It introduces fundamental concepts, advanced techniques, and best practices while introducing tools and libraries within the R ecosystem. It will train learners to interpret, design, and communicate insights effectively with real-world applications that bring into closer view the role of data visualization in decision-making.

**Course Objectives:**

- Develop a good understanding of the theoretical underpinnings of data visualization, including principles of clarity, accuracy, and storytelling.
- Learn how to use R programming and its visualization libraries such as ggplot2, plotly, and sf to create a range of charts and graphs.
- Learn to clean, manipulate, and prepare data effectively for visualization using R's data wrangling packages like dplyr and tidyr.
- Explore advanced visualization techniques, including geospatial mapping, interactive dashboards, and visualizations for complex datasets such as networks and time series.
- Understand how to design and present visualizations that clearly communicate insights, supported by reproducible reports and presentations using R Markdown.
- Demonstrate the ability to apply data visualization methods to real-world problems from a variety of domains, including business, healthcare, and environmental studies, through case studies and projects.

**Course Outcomes:**

Learner will be able to:

CO1: Understand and apply data visualization principles to enhance decision-making and avoid common pitfalls.

CO2: Demonstrates competence in using R and key libraries for visualization (ggplot2, dplyr, plotly) for data analysis.

CO3: Create and customize appropriate visualizations, such as scatter plots, bar charts, and histograms.

CO4: Prepare and maintain data for visualization through transformation and tidy data principles.

CO5: Improve advanced visualizations for multivariate, time series, and geospatial data, both statically and interactively.

CO6: Design accessible, effective visualizations using strong communication and aesthetic principles for diverse audiences.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Data Visualization and R Basics	Importance of Data Visualization: Role in data analysis and decision-making, Definition and importance of data visualization in analytics and decision-making, Principles of effective visualization (clarity, simplicity, and accuracy), how to avoid misleading visualizations, Differences between exploratory and explanatory data visualization. Components: data, visual encodings, and context, Understanding visual perception and cognitive load. Introduction to R Programming: Overview of R and RStudio, Key libraries for visualization: ggplot2, dplyr, plotly Understanding Data Structures in R: Vectors, data frames, tibbles, and lists, Loading and exploring datasets in R	5
2	Fundamentals of Data Visualization	Types of Data and Their Visualization Needs: Categorical, numerical, temporal, and geospatial data, Matching chart types to data types. Overview of Chart Types; Scatter plots, bar charts, and line charts, Histograms, density plots, boxplots, and pie charts The Grammar of Graphics (ggplot2): Understanding layers: data, aesthetics, and geometries, Customizing plots with themes, labels, and legends. Understanding data mappings and coordinates Best Practices for Chart Selection: Choosing appropriate charts for categorical, numerical, and temporal data.	5
3	Data Preparation for Visualization	Data transformation: filtering, aggregating, and reshaping. Tidy Data Principles: Importance of structured data for visualization, Using tidyr and dplyr for data preparation.	5

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Module No.	Module Name	Content	No of Hours
		Handling Large Datasets: Sampling techniques and data summarization. Efficient visualization strategies for big data	
4	Advanced Visualization Techniques	Visualization of Multivariate Data: Techniques for high-dimensional data (e.g., scatterplot matrices, parallel coordinates), Visualizing clustering and classification results. Multi-Panel Visualizations: Faceting techniques for subset comparison, Overlaying plots and combining visualizations Time Series Visualizations: Trend lines and seasonal patterns, Temporal patterns and trends, Smoothing and seasonal decomposition Geospatial Visualizations: Mapping spatial data and geospatial patterns, Incorporating layers, heatmaps, and choropleth maps, maps with ggplots and sf	5
5	Design Principles and Aesthetic Customization	Designing Visualizations for Communication: Structuring narratives for data-driven presentations, Color Theory and Accessibility: Effective use of color in data visualization, Ensuring accessibility (e.g., colorblind-friendly palettes), Customizing Visualization Elements: Titles, labels, legends, and annotations for clarity, Layout and spacing for better readability.	
6	Interactive and Specialized Visualizations	Interactive Visualization Concepts: The need for interactivity in data exploration, Overview of tools for creating interactive visualizations Specialized Visualization Types: Network visualizations (e.g., node-link diagrams), Statistical visualizations: regression plots, confidence intervals, and distributions, Representing regression results and confidence intervals, Diagnostic plots and residual analysis Tree maps and hierarchical data visualizations, Visualization for Big Data, Techniques for summarizing and aggregating large datasets, Sampling and visual encoding strategies	5
<b>Total</b>			<b>30</b>

**Textbooks:**

1. R for Data Science by Hadley Wickham and Garrett Grolemund
2. Data Visualization: A Practical Introduction by Kieran Healy

**Reference books:**

1. Practical Data Science with R by Nina Zumel and John Mount

**Course Name:** Data visualization using R Programming

**Course Code:** HMIT10P

**Category:** Honors in Next-Gen DS

**Preamble:**

The Data & Feature Engineering Lab provides hands-on experience in applying data preprocessing and feature engineering techniques to real-world datasets. Students will learn to collect, clean, preprocess, and transform data to prepare it for analysis and modeling. In the feature engineering process, you start with your raw data and use your own domain knowledge to create features that will make your machine learning algorithms work. In this module we explore what makes a good feature. Through practical exercises and projects, students will develop proficiency in using tools and libraries commonly employed in data engineering tasks.

**Prerequisites:** Skill Based Lab-Python

**Objective:**

- Master R programming and manipulate various data structures effectively.
- Perform exploratory data analysis (EDA) and analyze data patterns.
- Match appropriate visualizations to different data types for meaningful insights.
- Create and customize visualizations using the grammar of graphics (ggplot2).
- Transform and prepare data for visualization using dplyr and tidyr.
- Visualize high-dimensional and geospatial data and communicate insights clearly.

**Course Outcomes:**

Learner will be able to:

CO1: Apply R and RStudio tools to manipulate and explore data structures.

CO2: Perform basic exploratory data analysis and find insights in the data.

CO3: Select and apply the appropriate visualizations for categorical and numerical data.

CO4: Create and customize visualizations using ggplot2 and the grammar of graphics.

CO5: Transform and aggregate data for visualization using dplyr and tidyr.

CO6: Visualize high-dimensional and geospatial data and effectively communicate insights.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested list of experiments:**

Sr. No.	List of experiments
1	Introduction to R and RStudio
2	Create, access, and modify various data structures in R
3	Loading and Exploring Datasets and perform basic exploratory data analysis (EDA).
4	Visualizing Categorical and Numerical Data and Match the right chart type to different data types
5	Understand the grammar of graphics and create plots like scatter plots, line charts, and box plots using ggplot2
6	Data transformation techniques for data visualization (filtering, aggregating, reshaping).Using dplyr and tidyr to filter and aggregate a dataset
7	Implement data sampling techniques, perform summarization
8	Visualize high-dimensional data using techniques like scatterplot matrices and parallel coordinates.
9	Visualize geospatial data using ggplot2 and sf using choropleth maps
10	Design effective visualizations for storytelling and communication.

**Textbooks:**

1. R for Data Science by Hadley Wickham and Garrett Grolemund
2. Data Visualization: A Practical Introduction by Kieran Healy

**Reference books:**

1. Practical Data Science with R by Nina Zumel and John Mount

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**Course Name:** Time Series and Forecasting & Time Series and Forecasting Lab

**Course Code:** HMIT11T

**Vertical/ Sub-Vertical:**

**K-S-A Mapping:** Knowledge & Skill

**Pre-requisite required:** Probability and Statistics, Linear Algebra, Calculus

**Pre-requisite for:** Advanced Forecasting Techniques, Financial Analytics / Quantitative Finance, Machine Learning for Sequential Data

**Recommended Semester:** 7

**Course Scheme:**

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
HMIT11T	2	-	2	-
HMIT11P	-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory (HMIT11T)	15 (20%)	20 (30%)	40 (50%)	75 (100%)
Practical (HMIT11P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Preamble:**

The course Time Series and Forecasting introduce students to the analysis of time-dependent data, focusing on identifying patterns, modeling trends and seasonality, and forecasting future values. It combines statistical techniques with practical implementation using tools like Python/R, preparing students for real-world applications in finance, economics, environmental science, and engineering.

**Course Objectives:**

- To develop a strong foundation in time series concepts, including trend, seasonality, stationarity, and autocorrelation, along with their significance in real-world data analysis.
- To equip students with practical skills to apply statistical and machine learning-based forecasting techniques using tools like Python or R.

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- To enable critical thinking and problem-solving by analyzing time-dependent data and designing effective forecasting models for domains such as finance, healthcare, environment, and operations.

**Course Outcomes:**

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	To recall fundamental concepts and terminology related to time series data and forecasting methods.	Remembering
CO2	To explain the components of time series data and the theoretical foundations of various forecasting models.	Understanding
CO3	To apply classical and modern forecasting models (e.g., ARIMA, exponential smoothing) to real-world time series datasets.	Applying
CO4	To analyze time series data using decomposition, autocorrelation, and diagnostic tools to identify suitable forecasting techniques.	Analysing
CO5	To evaluate the accuracy and performance of different forecasting models using standard metrics and validation methods.	Evaluating
CO 6	To design and implement complete forecasting solutions for practical problems using programming tools and domain-specific data.	Creating

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Time Series Analysis	Definition and examples of time series Components: trend, seasonality, cyclicity, noise Types: univariate vs. multivariate, discrete vs. continuous Time series visualization Applications across domains (finance, healthcare, environment) <ul style="list-style-type: none"> <li>• <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>○ Exploring open time series datasets</li> <li>○ Domain-wise application studies</li> </ul> </li> </ul>	2
2	Time Series Decomposition and Smoothing	Additive vs. multiplicative models Moving average, weighted moving average Exponential smoothing: SES, DES (Holt), TES (Holt-Winters) STL decomposition (Seasonal-Trend decomposition) <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>• Visualization and implementation using</li> </ul>	5

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		Python/R/Excel Hands-on experimentation with smoothing methods	
3	Stationarity and ARIMA Modeling	Stationarity: concept, importance, visual detection Differencing and transformations ACF and PACF Unit root tests: ADF, KPSS AR, MA, ARMA, ARIMA models Model selection: AIC, BIC <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>• ACF/PACF analysis on sample datasets</li> <li>• Using Python (statsmodels) for ARIMA</li> </ul>	5
4	Advanced Time Series Models	Seasonal ARIMA (SARIMA), SARIMAX Vector Autoregression (VAR) Granger causality Cointegration Introduction to state space models and Kalman filters <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>○ Application of VAR and SARIMAX in real-world datasets</li> <li>○ Financial time series examples</li> </ul>	6
5	Machine Learning for Time Series Forecasting	Time-based feature engineering (lags, rolling windows) Train-test split for time series Regression models: Decision Tree, Random Forest Basics of deep learning: RNN, LSTM Evaluation metrics: RMSE, MAE, MAPE <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>• Hands-on with ML models using Python (scikit-learn, Keras)</li> <li>• Walk-forward validation techniques</li> </ul>	5
6	Applications, Case Studies & Project Work	Case studies: stock market, weather prediction, demand forecasting Forecasting dashboard basics (e.g., Streamlit/Flask for Python) Ethics in forecasting Mini-project: problem selection, modeling, evaluation, and presentation <b>Self-Learning Topics:</b> <ul style="list-style-type: none"> <li>• Deployment tools for model sharing</li> <li>• Business storytelling with data</li> </ul>	2
<b>Total</b>			<b>30</b>

**Suggested List of Practicals:**

<b>Sr No.</b>	<b>Suggested Topic(s)</b>
1	Time Series Visualization and Component Analysis
2	Smoothing Techniques: MA, WMA, and Exponential Smoothing
3	Stationarity Testing using ADF and KPSS Tests
4	ARIMA Model Building and Forecasting
5	Seasonal ARIMA (SARIMA) Model for Periodic Data
6	Vector Autoregression (VAR) for Multivariate Time Series
7	Feature Engineering for ML-based Time Series Forecasting
8	Forecasting using Decision Tree and Random Forest
9	LSTM Model for Sequence Forecasting (Deep Learning)
10	Mini-Project: End-to-End Forecasting Pipeline

**Course Name:** Data Ethics and Privacy & Data Ethics and Privacy Lab

**Course Code:** HMIT12T & HMIT12P

**Vertical/ Sub-Vertical:**

**K-S-A Mapping:** Knowledge & Skill

**Pre-requisite required:** Computer Networks, Introduction to Artificial Intelligence, Database Management Systems

**Pre-requisite for:** -

**Recommended Semester:** 8

**Course Scheme:**

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
HMIT12T	2	-	2	-
HMIT12P	-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory (HMIT12T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (HMIT12P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Preamble:**

In the era of data-driven decision making, ensuring ethical handling and privacy of data is paramount. This course equips students with the foundational principles of data ethics, privacy laws, and responsible data usage. It explores the ethical dilemmas, legal frameworks, and technical measures needed to protect individual rights and societal values in the digital age. The subject prepares students to develop and deploy data-centric solutions with accountability, transparency, and fairness.

**Course Objectives:**

- Understand fundamental principles of data ethics and privacy, including key concepts, challenges, and societal implications.
- Analyze legal and regulatory frameworks governing data protection and privacy in different jurisdictions.
- Apply ethical decision-making and privacy-preserving techniques to design responsible data-driven systems.

**Course Outcomes:**

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental concepts of data ethics, privacy, and related terminologies.	Remembering
CO2	Explain the importance of data privacy and ethical considerations in data usage and management.	Understanding
CO3	Apply relevant data protection laws and ethical guidelines to real-world data handling scenarios.	Applying
CO4	Analyze ethical dilemmas and privacy challenges in data-driven applications and technologies..	Analysing
CO5	Evaluate different privacy-preserving techniques and ethical frameworks for compliance and effectiveness.	Evaluating
CO 6	Design data-driven systems and policies that integrate ethical principles and privacy safeguards.	Creating

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Data Ethics and Privacy	<p><b>Learning Objective:</b> To introduce students to the fundamental concepts, importance, and scope of data ethics and privacy.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Definition and history of data ethics</li> <li>• Importance of ethics in data handling</li> <li>• Key concepts: data privacy, confidentiality, consent, ownership</li> <li>• Overview of ethical challenges in data science and AI</li> <li>• Privacy principles and ethical frameworks</li> </ul> <p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>• Case studies of ethical breaches in data use</li> <li>• Research on ethical codes (ACM, IEEE)</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>• LO1.1: Define key terms related to data ethics and privacy (PI 1.4.1) (CO1)</li> <li>• LO1.2: Explain the importance of ethical considerations in data usage (PI 6.1.2) (CO2)</li> </ul>	2
2	Ethical Theories and Frameworks in Data	<p><b>Learning Objective:</b> To understand various ethical theories and</p>	5

Module No.	Module Name	Content	No of Hours
		<p>frameworks applicable to data ethics.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Overview of normative ethical theories: utilitarianism, deontology, virtue ethics</li> <li>• Ethical decision-making models</li> <li>• Principles of fairness, accountability, transparency (FAT)</li> <li>• Stakeholders and their responsibilities in data ecosystems</li> </ul> <p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>• Compare different ethical theories with real-world examples</li> <li>• Analyze a data ethics dilemma using multiple frameworks</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>• LO2.1: Summarize major ethical theories relevant to data (PI 8.1.2 ) (CO2)</li> <li>• LO2.2: Apply ethical frameworks to analyze data-related dilemmas (PI 8.2.3) (CO4)</li> </ul>	
3	Legal and Regulatory Landscape for Data Privacy	<p><b>Learning Objective:</b> To familiarize students with major data protection laws and regulatory standards worldwide.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Overview of GDPR, HIPAA, CCPA, and other major regulations</li> <li>• Data subject rights and data controller responsibilities</li> <li>• Consent and data breach notification requirements</li> <li>• Cross-border data flow and compliance challenges</li> </ul> <p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>• Study a selected privacy law in detail</li> <li>• Research recent legal cases involving data privacy violations</li> </ul>	5

Module No.	Module Name	Content	No of Hours
		<p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>LO3.1: Identify key provisions of major data privacy laws (PI 6.2.1) (CO3)</li> <li>LO3.2: Interpret the implications of legal requirements on data management (PI 6.2.3) (CO3)</li> </ul>	
4	Privacy-Preserving Technologies and Techniques	<p><b>Learning Objective:</b> To explore technical methods for protecting data privacy and minimizing risks.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>Data anonymization and pseudonymization</li> <li>Differential privacy and its applications</li> <li>Encryption and secure data storage</li> <li>Access control and identity management</li> <li>Emerging techniques: federated learning, homomorphic encryption</li> </ul> <p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>Hands-on with open-source privacy tools</li> <li>Review recent research on privacy-enhancing technologies</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>LO4.1: Describe various privacy-preserving techniques (PI 5.1.1) (CO5)</li> <li>LO4.2: Apply suitable techniques to protect sensitive data (PI 5.1.3) (CO5)</li> </ul>	6
5	Ethical Issues in AI and Data-Driven Systems	<p><b>Learning Objective:</b> To analyze ethical challenges in AI, machine learning, and automated decision-making.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>Algorithmic bias and fairness</li> <li>Transparency and explainability of AI models</li> <li>Accountability in automated systems</li> <li>Social impact and unintended consequences of AI</li> <li>Case studies of ethical dilemmas in AI deployments</li> </ul>	5

Module No.	Module Name	Content	No of Hours
		<p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>Explore datasets for bias and fairness analysis</li> <li>Review prominent AI ethics guidelines</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>LO5.1: Identify sources of bias and ethical risks in AI (PI 7.1.1) (CO5)</li> <li>LO5.2: Evaluate methods to improve fairness and transparency (PI 8.2.5) (CO5)</li> </ul>	
6	Designing Responsible Data Systems and Policies	<p><b>Learning Objective:</b> To enable students to design data systems and organizational policies incorporating ethical and privacy principles.</p> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>Privacy by design and default principles</li> <li>Ethical data governance frameworks</li> <li>Risk assessment and mitigation strategies</li> <li>Developing data usage policies and user consent mechanisms</li> <li>Role of audits and compliance monitoring</li> </ul> <p><b>Self-Learning Topics:</b></p> <ul style="list-style-type: none"> <li>Draft a data privacy policy for a hypothetical organization</li> <li>Conduct a risk assessment for a data system</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>LO6.1: Design data systems integrating privacy and ethics principles (PI 3.4.6) (CO6)</li> <li>LO6.2: Develop organizational policies for ethical data management (PI 6.1.5) (CO6)</li> </ul>	2
<b>Total</b>			<b>30</b>

**Suggested List of Practicals:**

Sr No.	List of experiments
1.	<p>Case Study Analysis of Data Ethics Breaches</p> <p>Learning Outcomes: A learner will be able to:</p> <p>1.1 Identify ethical violations in real-world data usage cases. (PI 8.1.1 ) (CO1)</p>

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	1.2 Analyze the impact of unethical data practices on individuals and society. (PI 6.1.2 ) (CO2)
2.	Applying Ethical Frameworks to Data Dilemmas Learning Outcomes: A learner will be able to: 2.1 Apply ethical theories such as utilitarianism and deontology to data scenarios. (PI 8.2.3 ) (CO2) 2.2 Evaluate the consequences of different ethical decisions. (PI 8.2.5 ) (CO4)
3.	Comparative Study of Data Privacy Laws Learning Outcomes: A learner will be able to: 3.1 Summarize key provisions of GDPR, HIPAA, and CCPA. (PI 6.2.1) (CO3) 3.2 Compare and contrast legal requirements across jurisdictions. (PI 6.2.3) (CO3)
4.	Implementing Data Anonymization Techniques Learning Outcomes: A learner will be able to: 4.1 Apply anonymization and pseudonymization to sample datasets. (PI 5.1.3) (CO4) 4.2 Assess the effectiveness of privacy-preserving methods. (PI 5.3.5) (CO5)
5.	Bias Detection in AI Models Learning Outcomes: A learner will be able to: 5.1 Identify bias in sample AI datasets or models. (PI 7.1.1) (CO5) 5.2 Suggest strategies to mitigate bias and improve fairness. (PI 8.2.5) (CO5)
6.	Designing a Data Privacy Policy for an Organization Learning Outcomes: A learner will be able to: 6.1 Develop a data privacy policy incorporating legal and ethical guidelines. (PI 3.4.6) (CO6) 6.2 Justify policy choices based on ethical and regulatory standards. (PI 6.1.5) (CO6)

**Performance Indicators:**

1.4.1 Identify key concepts and tools in specialized areas such as computer architecture, AI, or network systems.

3.4.6 Finalize the design solution, incorporating feedback and ensuring compliance with societal, environmental, and ethical considerations.

5.1.1 List commonly used modern engineering and IT tools relevant to computer engineering tasks.

5.1.3 Implement modern tools or techniques to address a specific engineering challenge.

5.3.5 Assess the appropriateness of tools for predictive modeling or system design in light of constraints like accuracy, cost, or scalability.

6.1.2 Explain the impact of engineering solutions on societal, health, safety, legal, and cultural contexts.

6.1.5 Assess the ethical and social responsibilities of engineers in addressing public welfare and sustainability issues.

6.2.1 Identify key professional engineering codes, standards, and regulations applicable to engineering practice.

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- 6.2.3 Use relevant engineering standards or codes to ensure compliance in a specific project or scenario.
- 7.1.1 Identify risks/impacts in the life-cycle of an engineering product or activity.
- 8.1.1 Identify situations of unethical professional conduct and propose ethical alternatives.
- 8.1.2 Engage in discussions on ethical case studies with sensitivity to different viewpoints.
- 8.2.3 Examine and apply moral & ethical principles to known case studies.
- 8.2.5 Critique a decision or design based on alignment with ethical standards.

**Mapping of Course Outcomes with Learning Outcomes:**

	Mapped to Learning Outcomes
<b>CO1</b>	1.1, 1.2
<b>CO2</b>	2.1,2.2
<b>CO3</b>	3.1,3.2
<b>CO4</b>	4.1,4.2
<b>CO5</b>	5.1,5.2
<b>CO6</b>	6.1,6.2

**Mapping of Course Outcomes with Programme Outcomes:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1/14							1/14				
CO2						1/14		2/14				
CO3						2/14						
CO4					1/14			1/14				
CO5					1/14		1/14	1/14				
CO6			1/14			1/14						

**Mapping of Course Outcomes with Programme Specific Outcomes:**

CO	PSO1	PSO2	PSO3
CO1	1/14	1/14	
CO2		3/14	
CO3		2/14	
CO4		2/14	
CO5		3/14	
CO6	1/14	1/14	

**Course Name:** IT Security Strategic Planning, Policy, and Leadership

**Course Code:** HMIT13T

**Category:** Honours in Next-Gen Cyber Security

**Preamble:**

In the rapidly evolving digital landscape, organizations face complex and persistent cybersecurity challenges. IT Security Strategic Planning and Policy is a critical discipline that empowers professionals to design and implement structured approaches to safeguarding information assets. This course aims to equip learners with the knowledge and tools required to develop comprehensive security strategies and policies aligned with organizational goals and regulatory requirements.

**Pre-requisites:** Computer Networks, Computer Network & Security

**Course Objectives:**

1. Understand the principles and significance of IT security strategic planning.
2. Learn the structure and components of IT security policies.
3. Explore methods for performing risk assessments and integrating them into strategic plans.
4. Gain knowledge of compliance with regulatory frameworks and standards.
5. Understand the evaluation and maintenance of security policies.

**Course Outcomes:**

Learner will be able to:

CO1: Explain the key components of IT security strategic planning.

CO2: Design theoretical IT security policies for organizational use.

CO3: Perform conceptual risk assessments and recommend appropriate mitigations.

CO4: Evaluate compliance requirements and propose strategies for regulatory adherence.

CO5: Assess and refine IT security policies based on organizational needs and industry best practices.

CO6: Utilize metrics to evaluate the effectiveness of security strategies.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to IT Security Strategic Planning	Definition and importance of strategic planning in IT security. Alignment of IT security strategies with business objectives. Overview of security frameworks: NIST CSF, ISO 27001, COBIT.	4
2	Fundamentals of IT Security Policies	Policy structure: Definitions, objectives, scope, and responsibilities. Types of IT security policies: Acceptable use, data protection, access control, and incident management. Policy lifecycle: Development, approval, communication, and review.	6
3	Risk Management and Business Impact Analysis	Risk assessment fundamentals: Threats, vulnerabilities, and impact. Risk management methodologies (e.g., NIST SP 800-30). Business Impact Analysis (BIA): Identifying critical assets and dependencies.	6
4	Regulatory and Compliance Requirements	Introduction to major regulations: GDPR, HIPAA, PCI DSS, SOX. Compliance as part of IT security strategy. Industry best practices for achieving and maintaining compliance.	6
5	Security Metrics and Policy Evaluation	Security metrics: Types, importance, and measurement techniques. Methods for evaluating the effectiveness of security policies. Reporting and improving policies using feedback and audit results.	4
6	Emerging Trends and Challenges in IT Security Strategic Planning	Emerging security threats and their impact on strategic planning: Advanced Persistent Threats (APTs), ransomware, and zero-day vulnerabilities. Incorporating Artificial Intelligence (AI) and Machine Learning (ML) in IT security strategies. Cloud security considerations in policy development. Challenges in aligning policies with new technologies such as IoT and blockchain. Future directions in IT security frameworks and standards.	4
<b>Total</b>			<b>30</b>

**Textbooks:**

1. "Information Security Policies, Procedures, and Standards: A Practitioner's Reference" by Douglas J. Landoll
2. "Managing Risk in Information Systems" by Darril Gibson
3. Cybersecurity and Cyberwar: What Everyone Needs to Know by P.W. Singer and Allan Friedman

**Reference Books:**

1. "Handbook of Digital Forensics and Investigation" edited by Eoghan Casey
2. "Windows Forensic Analysis Toolkit: Advanced Analysis Techniques for Windows 10" by Harlan Carvey
3. "Network Forensics: Tracking Hackers through Cyberspace" by Sherri Davidoff and Jonathan Ham
4. "Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation" by Lee Reiber

**Course Name:** IT Security Strategic Planning, Policy, and Leadership Lab

**Course Code:** HMIT13P

**Category:** Honours in Next-Gen Cyber Security

**Preamble:**

This lab course provides practical, hands-on experience in developing, implementing, and evaluating IT security strategies, policies, and leadership practices. Through real-world simulations, case studies, and group projects, students will apply strategic planning frameworks, draft security policies, and practice leadership skills required for effective IT governance and risk management.

**Pre-requisites:** Computer Networks Lab- IT06P, Operating system Lab- IT05P, Computer & Network Security Lab- IT24P

**Course Objectives:**

1. By the end of this course, students will be able to:
2. Design and implement strategic security plans aligned with organizational goals.
3. Develop IT security policies addressing regulatory and business requirements.
4. Use leadership and communication techniques to manage security teams effectively.
5. Conduct risk assessments and propose mitigation strategies.
6. Collaborate in a team to solve complex cybersecurity challenges.

**Course Outcomes:**

Learner will be able to:

LO1: Develop Comprehensive IT Security Strategies

LO2: Draft and Evaluate IT Security Policies

LO3: Conduct Effective Risk Assessments

LO4: Lead and Manage Cybersecurity Teams

LO5: Implement and Evaluate Incident Response Plans

LO6: Monitor and Report Cybersecurity Metrics

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	1	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

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The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested List of Practicals:**

Sr No.	Title of Practicals
1	Course Overview and Lab Setup <ul style="list-style-type: none"><li>• Overview of IT security leadership and strategic planning.</li><li>• Introduction to lab tools and virtual environments.</li><li>• Basics of organizational alignment in security planning.</li></ul>
2	Risk Assessment and Business Impact Analysis <ul style="list-style-type: none"><li>• Conducting a risk assessment using industry frameworks (e.g., NIST, ISO).</li><li>• Analyzing and presenting business impact findings.</li></ul>
3	Designing IT Security Strategies <ul style="list-style-type: none"><li>• Hands-on: Creating a strategic security plan.</li><li>• Balancing security with business objectives.</li></ul>
4	IT Security Policy Development <ul style="list-style-type: none"><li>• Drafting an IT security policy document (e.g., access control, incident response).</li><li>• Addressing compliance requirements (e.g., GDPR, HIPAA).</li></ul>
5	Incident Response Planning <ul style="list-style-type: none"><li>• Developing an incident response plan and playbook.</li><li>• Lab simulation: Responding to a security breach.</li></ul>
6	Governance, Risk, and Compliance (GRC) <ul style="list-style-type: none"><li>• Lab exercises in setting up GRC dashboards.</li><li>• Conducting compliance audits and presenting findings.</li></ul>
7	Security Awareness and Training Programs <ul style="list-style-type: none"><li>• Designing employee security awareness programs.</li><li>• Delivering mock training sessions for end-users.</li></ul>
8	Cybersecurity Metrics and Reporting <ul style="list-style-type: none"><li>• Creating and analyzing security dashboards and reports.</li><li>• Lab: Presenting key metrics to a mock C-suite team.</li></ul>

**Textbooks:**

1. "Information Security Policies, Procedures, and Standards: A Practitioner's Reference" by Douglas J. Landoll

**Reference Books:**

1. "CISO Desk Reference Guide: A Practical Guide for CISOs" by Bill Bonney, Gary Hayslip, and Matt Stamper
2. "Managing Risk in Information Systems" by Darril Gibson
3. "IT Security Governance Guidebook with Security Program Metrics on CD-ROM" by Fred Cohen
4. "NIST Cybersecurity Framework: A Pocket Guide" by Alan Calder
5. "Cybersecurity Leadership: Powering the Modern Organization" by Mansur Hasib

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**Course Name:** Advanced Threat Intelligence and Penetration Testing

**Course Code:** HMIT14T

**Vertical/ Sub-Vertical:** PE

**K-S-A Mapping:** Knowledge & Skill

**Pre-requisite required:** Computer Networks (IT06T)

**Pre-requisite for:** IT62T (Detection & Mitigation of Cyber Threats)

**Recommended Semester:** 7

**Course Scheme:**

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
HMIT14T	2	-	2	-
HMIT14P	-	2	-	1

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
HMIT14T	15 (20%)	20 (30%)	40 (50%)	75 (100%)
HMIT14P	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Preamble:**

This course explores the landscape of cyber threats and countermeasures. It introduces students to advanced threat intelligence concepts, attack simulation techniques, and penetration testing methodologies. Students gain hands-on experience in discovering, analysing, and mitigating real-world security vulnerabilities.

**Course Objectives:**

- Understand the advanced concepts in cyber threat intelligence and actor profiling.
- Perform vulnerability assessments and penetration testing on networked environments.
- Use industry-standard tools to collect, process, and report threat intelligence.
- Apply ethical and legal considerations in offensive security practices.

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**Course Outcomes:**

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Describe the principles of threat intelligence and penetration testing	Remembering
CO2	Identify and classify threat actors, TTPs, and attack vectors using threat models	Understanding
CO3	Conduct penetration tests using tools and techniques across various attack surfaces	Applying
CO4	Analyse threat data and penetration test results to assess organizational risks	Applying
CO5	Design threat reports and penetration test documentation with actionable recommendations	Creating

**Detailed Syllabus:**

Module No.	Module Name	Content	No of Hours
1	Introduction to Threat Intelligence	Definitions and types of threat intelligence (Strategic, Tactical, Operational, Technical), Threat intelligence lifecycle, Threat actors and motivations <b>Self-Learning Topics:</b> Cyber kill chain, Threat hunting basics	4
2	Threat Intelligence Tools and Techniques	STIX/TAXII standards, MITRE ATT&CK framework, MISP, OpenCTI, OSINT tools, IOCs and TTPs. <b>Self-Learning Topics:</b> YARA rules, Passive DNS, WHOIS lookups	6
3	Introduction to Penetration Testing	Phases of penetration testing; ethics and legal considerations; vulnerability scanning tools (Nessus, OpenVAS); CVEs and CVSS; Metasploit basics. <b>Self-Learning Topics:</b> SAST vs. DAST, manual code reviews, OSCP/CEH overview	6
4	Network and Web Application Testing	Network scanning (Nmap), Web application testing (Burp Suite, Nikto); OWASP Top 10 (SQLi, XSS, LFI); exploitation walkthroughs. <b>Self-Learning Topics:</b> Gobuster, Hydra, ZAP Proxy	6
5	Threat Reporting and Risk Mitigation	Types of reports (technical, executive); report structure; TTP documentation; risk ratings and mitigation strategy formulation. <b>Self-Learning Topics:</b> NIST Framework, ISO/IEC 27001	4
6	Case Studies and Emerging Threat Trends	Case studies (APT29, Lazarus, SolarWinds); current threat landscapes; dark web intelligence; threat hunting practices.	4

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		<b>Self-Learning Topics:</b> Threat feeds (VirusTotal, OTX), annual threat reports (Mandiant, DBIR)	
<b>Total</b>			<b>30</b>

**Suggested List of Practicals:**

<b>Sr No.</b>	<b>Suggested Topic(s)</b>
1.	Configure MISP and integrate a threat feed
2.	Map attacker techniques using MITRE ATT&CK Navigator
3.	Perform active and passive OSINT collection (e.g., Shodan, WHOIS, Google Dorks)
4.	Scan a network using Nmap and interpret port/service results
5.	Perform vulnerability assessment using Nessus or OpenVAS
6.	Exploit a system using Metasploit (e.g., SMB exploit)
7.	Conduct a web application attack using Burp Suite (e.g., SQLi or XSS on DVWA)
8.	Prepare a structured technical + executive report of test findings and recommendations

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**Course Name:** Advanced Computer Forensics Analysis

**Course Code:** HMIT15T

**Category:** Honour – Minor (Advanced Cyber security)

**Pre-requisites:**

- Computer Network Security
- System Security and Ethical Hacking
- Digital Forensics

**Course Objectives:**

- To understand the nature and evolution of cyber threats and attack vectors.
- To learn various threat detection methodologies used in cybersecurity.
- To explore mechanisms and tools for mitigating different types of cyber threats.
- To understand the role of security frameworks and standards in cyber threat defense.
- To analyze case studies involving cyberattacks and their mitigation techniques.

**Course Outcomes:**

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

CO1: Identify and classify various types of cyber threats and vulnerabilities.

CO2: Explain the principles and techniques used in cyber threat detection.

CO3: Describe defense strategies including security technologies and policies.

CO4: Evaluate cybersecurity frameworks and their application in threat mitigation.

CO5: Analyze real-world cyber incidents to derive threat mitigation approaches.

CO6: Demonstrate awareness of current trends and tools in cyber threat intelligence.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

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The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall decide her/his assessment methodology based on the course's nature. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment guidelines:**

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

Sr. No.	Module	Detailed Content	Hrs
1	Introduction to Cyber Threats	Types of threats: malware, phishing, ransomware, insider threats, DDoS, APTs. Threat actors and motives. Threat intelligence lifecycle. OWASP Top 10.	5
2	Threat Detection Techniques	Signature-based vs. anomaly-based detection. Host-based and network-based detection. Behavioral analysis. Indicators of compromise (IoCs).	5
3	Cyber Threat Intelligence (CTI)	Threat intelligence sources, feeds, and platforms. STIX, TAXII standards. Open-source intelligence (OSINT). Role of CTI in threat detection.	5
4	Mitigation Techniques & Incident Response	Mitigation strategies: patching, segmentation, access control, encryption. Incident response process (NIST model). Containment, eradication, and recovery steps.	5
5	Security Technologies & Tools	Firewalls, antivirus, IDS/IPS, endpoint detection & response (EDR), security information and event management (SIEM). Modern defense tools (EDR/XDR, SOAR).	5
6	Cybersecurity Frameworks & Case Studies	MITRE ATT&CK, NIST CSF, ISO/IEC 27001. Case studies: SolarWinds, WannaCry, Target breach. Lessons learned and best practices.	5
<b>Total</b>			<b>30</b>

**Textbooks**

1. William Stallings, Computer Security: Principles and Practice, 4th Edition, Pearson, 2023.
2. Eric Conrad, Seth Misener, Joshua Feldman, CISSP Study Guide, Syngress, 4th Edition.

**Reference Books**

1. Michael Sikorski & Andrew Honig, Practical Malware Analysis, No Starch Press.
2. Chris Sanders, Applied Network Security Monitoring, Syngress.
3. Paul E. Proctor, The Practice of Network Security Monitoring, No Starch Press.
4. MITRE ATT&CK Framework – <https://attack.mitre.org>
5. NIST SP 800-61 Rev. 2 – Computer Security Incident Handling Guide

**Course Name:** Embedded Linux System

**Course Code:** HMET01T\*

**Category:** Honours in Next-Gen IoT

**Preamble:**

The rapid growth of Linux as an embedded operating system in many products is due to the ease of using embedded Linux to replace home-grown operating systems. Linux-based embedded systems are widely used in smartphones, in-vehicle infotainment systems, in countless consumer electronics and for numerous industrial applications. It may be the need for TCP/IP networking, USB support, Secure Digital support, or some other standard that causes a company to dump their current operating system and switch to Linux. But it is the joy of developing with Linux that keeps the engineers promoting it for future products. The objective of the course is to give students solid introductory knowledge on Linux OS and internals of Linux for embedded system design.

**Pre-requisites:**

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

**Course Objectives:**

- To understand role of operating system in embedded system development.
- To understand architecture of operating systems for embedded system applications.
- To understand different types of kernels.
- To understand kernel module of Linux.
- To understand communication between user and operating system.
- Use Linux operating system in embedded system application.

**Course Outcomes:**

Learner will be able to:

CO1: Understand fundamental concepts of operating System.

CO2: Understand architecture of Linux operating system for embedded system applications.

CO3: Understand concept of kernel.

CO4: Use Linux kernel module.

CO5: Do communication between user space and kernel space.

CO6: Develop applications.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

**Assessment Guidelines:**

Head	ISA	MSA	ESE	Total (Passing @40% of total)
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Detailed Syllabus:**

Module No	Module name	Content	No of Hours
1	RTOS and Linux based Embedded Systems: An Introduction	Introduction to Real Time Operating Systems: Characteristics of RTOS, Tasks Specifications and types, Real-Time Scheduling Algorithms, Concurrency, Inter-process Communication and Synchronization mechanisms, Priority Inversion, Inheritance and Ceiling. Operating systems for embedded systems, Why Linux-based embedded systems? Linux evolution Embedded Linux Vs Desktop Linux, Embedded Linux Distributions, System calls, Static and dynamic libraries, Cross tool chains. Linux-based embedded system: example	05
2	Embedded Linux Architecture and Kernel Architecture	Architecture of Embedded Linux- Real Time Executive, Monolithic kernels, Microkernel.Linux Kernel Architecture- Hardware Abstraction Layer (HAL), Memory manager, Scheduler, File System, I/O and Networking subsystem, IPC. User space, Linux Start-up sequence.	05
3	Building and Debugging	Building the Kernel, Building Applications, Building the Root File System, Integrated Development Environment, Debugging Virtual Memory Problems, Kernel Debuggers, Profiling	05
4	Introduction to Linux kernel modules	Introduction, CPU – I/O interface, I/O interface with polling, I/O interface with interrupt, I/O interface, I/O interface latency, Direct memory access (DMA) architecture - transfer modes, I/O taxonomy, Typical operations, Linux devices, The Virtual File System (VFS) abstraction. Linux kernel modules – the initialization function, the cdev data structure, the initialization function, the clean-up function, custom VFS functions.	06
5	Communication Between Kernel and User Space	Introduction, The reference use case, The CPU/Device interface, The module level – file operations, ioctl() implementation, open()/release() implementation, read() implementation, Passing data to/from the kernel, write() implementation, communication with the device, Memory	06

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Module no	Module name	Content	No of Hours
		mapped I/O – initialization, clean-up, read, write, GPIO-based I/O – initialization, clean-up, read, write, Interrupts, Requesting the interrupt line, Freeing the interrupt line, The interrupt handler, Interrupt handling, Top-half and bottom-half, Needed support, Work queue, The user level, The user level – the application	
6	Porting Applications	Architectural Comparison, Application Porting Roadmap, Programming with Pthreads, Operating System Porting Layer (OSPL), Kernel API Driver.	03
<b>Total</b>			<b>30</b>

**Textbooks:**

1. "Embedded Linux System Design and Development", P Raghvan, Amol Lad, Sriram Neelakandan, Auerbach Publications.
2. "Mastering Embedded Linux Programming", Chris Simmonds Second Edition, PACKT Publications Limited.
3. "Embedded Linux Primer: A Practical Real World Approach", Christopher Hallinan, Prentice Hall, 2nd Edition, 2010

**Reference Books:**

1. "Building Imbedded Linux Systems", Karim Yaghmour, O'Reilly & Associates.
2. Embedded Linux Systems with the Yocto Project, Rudolf K. Sterif

**Course Name:** Embedded Linux System Laboratory

**Course Code:** HMET01P\*

**Category:** Honours in Next-Gen IoT

**Preamble:**

The rapid growth of Linux as an embedded operating system in many products is due to the ease of using embedded Linux to replace home-grown operating systems. Linux-based embedded systems are widely used in smartphones, in-vehicle infotainment systems, in countless consumer electronics and for numerous industrial applications. It may be the need for TCP/IP networking, USB support, Secure Digital support, or some other standard that causes a company to dump their current operating system and switch to Linux. But it is the joy of developing with Linux that keeps the engineers promoting it for future products. The objective of the course is to give students solid introductory knowledge on Linux OS and internals of Linux for embedded system design.

**Pre-requisites:**

- C Programming
- Object Oriented Programming
- Microprocessor and microcontroller

**Course Objectives:**

- To understand role of operating system in embedded system development.
- To understand architecture of operating systems for embedded system applications.
- To understand different types of kernels.
- To understand kernel module of Linux.
- To understand communication between user and operating system.
- Use Linux operating system in embedded system application.

**Course Outcomes:**

Student will be able to:

CO1: Demonstrate fundamental concepts of operating System.

CO2: Demonstrate architecture of Linux operating system for embedded system applications.

CO3: Demonstrate concept of kernel.

CO4: Use Linux kernel module with standard commands.

CO5: Establish communication from user space to kernel space.

CO6: Develop embedded system applications based on Linux operating system.

**Course Scheme:**

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

**Assessment Scheme:**

Head	ISA	MSA	ESE	Total
Practical	25	-	25	050

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

**Suggested List of Practical:**

1. Introduction to the Board and Workspace Set-Up.
2. Custom Embedded Linux Build Using the Manual Approach.
3. Introduction to Linux Kernel Modules under Yocto.
4. Handling General Purpose I/O Using Linux Kernel Modules.
5. Handling Hc-Sr04 Ranging Sensor Using Linux Kernel Modules.
6. Introduction to Code Development and Debugging Using Yocto.
7. Introduction to Linux Kernel and Application Profiling.
8. Installing Linux kernel and configuration of Rasp-berry Pi computer (SBC)
9. Installation of Free RTOS and integration with Keil IDE for multithreaded application.

**Practical can be designed using project based approach.**

**Textbooks:**

1. "Embedded Linux System Design and Development", P Raghvan, Amol Lad, Sriram Neelakandan, Auerbach Publications.
2. "Mastering Embedded Linux Programming", Chris Simmonds Second Edition, PACKT Publications Limited.
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