Program Specific Orientation Session

Master of Technology (M. Tech.)
in
Artificial Intelligence & Machine Learning

17th November 2024

Welcome to

Birla Institute of Technology and Science, Pilani

and

Work Integrated Learning Programmes (WILP)

Agenda

- Academic Guidelines for M.Tech. AIML Programme
- M.Tech. AIML - Programme Overview
- M.Tech. AIML - Programme Operations
- Operations Support
- Question & Answer

Academic Guidelines for M.Tech. AIML

Academic Guidelines (M. Tech. DSE & M.Tech. AIML)

2 Years, 4 Semesters programme

Year	First Semester			Second Semester		
	Course No.	Course Title	Units	Course No.	Course Title	Units
I	AIML* ZC416	Mathematical Foundations for Machine Learning	4	AIML* ZG511	Deep Neural Networks	4
	AIML* ZC418	Introduction to Statistical Methods	4	AIML* ZG512	Deep Reinforcement Learning	4
	AIML* ZG557	Artificial and Computational Intelligence	5		Elective 1	
	AIML* ZG565	Machine Learning	4		Elective 2	
		Total	17		Total	16
II		Elective 3		AIML* ZG628T	Dissertation	16
		Elective 4				
		Elective 5				
		Elective 6				
		Total	16		Total	16

- Minimum 16 units each in 2nd and 3rd semesters
- Dissertation is of 16 units, standalone
- Each unit corresponds to about 30 hours of effort

Sample Course Handout

BITS Pilani
Pilani | Dubai | Goa | Hyderabad

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

WORK INTEGRATED LEARNING PROGRAMMES

COURSE HANDOUT

Part A: Content Design

Course Title	Mathematical Foundations for Data Science
Course No(s)	
Credit Units	4
Course Author	G Venkiteswaran
Version No	2
Date	15.09.2019

Course Description

Vector and matrix algebra, systems of linear algebraic equations and their solutions; eigenvalues, eigenvectors and diagonalization of matrices; graphs and digraphs; trees, lists and their uses; partially ordered sets and lattices; Boolean algebras and Boolean expressions;

Course Objectives

No	Objective- The course aims to
CO1	Introduce concepts in linear algebra and to use it as a platform to model physical problems.
CO2	Provide techniques for analytical and numerical solutions of linear equations and introduce the concept of convergence.
CO3	Utilize concepts of linear algebra and calculus in solving optimization problems.
CO4	Introduce some of the mathematical structures, concepts and notations used in discrete mathematics.
CO5	Introduce some concepts from graph theory, partially ordered sets, Boolean algebras.

Text Book(s)

No	Author(s), Title, Edition, Publishing House
T1	Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India, 9 th Edition, 2011
T2	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw Hill, 7th Ed., 2011.

Reference Book(s) & other resources

No	Author(s), Title, Edition, Publishing House
R1	K Hoffman and R Kunze, Linear Algebra, Pearson Education, 2nd Edition, 2005.
R2	Kolman, Busby, Ross and Rehman, Discrete Mathematical Structures for Computer Science, Pearson Education, 6th Edition, 2017

Content Structure

No	Title of the module	References
M1	1. Matrices, System of equations, determinants and inverse of a matrix 1.1. Matrix Algebra-Row-reduced echelon form of a matrix, inverse of a matrix 1.2. System of linear equations, Consistency and inconsistency of system of linear equations	T1: Sec 7.1 – 7.3, 7.5, 7.8
M2	2. Vector spaces and Linear transformations 2.1 Vector space, subspace and span of a set, Linear dependence and independence of a set of vectors, basis and dimension 2.2. Linear transformation, rank and nullity	T1: Sec 7.4, 7.9, R1: Sec 3.2
M3	3. Eigenvalues, Eigenvectors and singular values 3.1. Eigenvalues 3.2. Eigenvectors 3.3. Singular value decomposition	T1: Sec 8.2, 8.3 and class notes
M4	4. Numerical linear algebra 4.1. Gauss elimination with partial pivoting and scaling 4.2. Iterative methods for solving linear system of equations	T1: Sec 20.1
M5	5. Matrix Eigenvalue Problems 5.1. Eigenvalue problems in linear system of equations 5.2. Power method for finding the dominant eigenvalue	T1: Sec 20.3, 20.8
M6	6. Linear and non-linear optimization 6.1 Basics of calculus 6.2 Linear optimization using simplex method and sensitivity 6.3 Non-linear optimization	Class notes
M7	6. Sets, Functions and Relations, Boolean Algebra 6.1 Introduction to set theory, set relations, set operators, cardinality of sets, Cartesian product of sets 6.2 Fundamentals of functions – range, domain, injection, surjection, bijection of functions 6.3 Fundamentals of relations, reflexive, symmetric and transitive properties in relations, representing relations, applications of relations, equivalence relations, partial order relations, lattices. 6.4 Boolean functions, representing Boolean functions	T2: Sec 2.1, 2.2, 2.3, 7.1 – 7.6, 10.1, 10.2
M8	7. Graph Theory 7.1 Introduction to graph theory, directed and undirected graphs, handshaking theorem, special graph structures, graph representations and isomorphism of graphs, connectedness, components, Euler, Hamilton paths and cycles	T2: Sec 8.1-8.5

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Sample Course Handout

Part B: Contact Session Plan

Academic Term	I semester 2018-2019
Course Title	Mathematical Foundations for Data Science
Course No	
Lead Instructor	

Course Contents

Contact Hours	List of Topic Title	Text/Ref Book/external resource
1	Introduction to matrices, row-reduced echelon form of a matrix, Consistency of linear systems and matrix inversion • Unary and binary operations and special matrices (orthogonal matrix, upper and lower triangular, diagonal and sparse) • Row reduction and determination of rank. Comparison to computation using determinants • Use of rank in determining the consistency and inconsistency of linear systems • Row reduction to determine the inverse of the matrix (the Gauss Jordan method) (this is to be used in Simplex method later on)	T1: Sec 7.1 – 7.3, 7.5, 7.8
2	Vector space, subspace and span, Linear dependence and independence, basis and dimension, Linear transformation, rank and nullity and the rank nullity theorem • Definition and examples of vector space (R^n, space of polynomials of finite degree, n x m matrices etc.,) • Determination of whether a non-empty set of a vector space is a subspace or not • Span of a finite set • Linear dependence and independence (theory and couple of examples) • Basis and dimension of a finite dimensional vector space	T1: Sec 7.4, 7.9 R1: Sec 3.2
	• Linear transformation T: V → W (definition and a couple of examples) • Range(T) and Ker(T) as subspaces of W and V respectively • Rank Nullity Theorem (statement without proof) with examples	
3	Eigenvalues and eigenvectors of a matrix with applications • Eigenvalues – definition and method of determination of eigenvalues • Eigenvectors – definition and methods of finding the eigenvectors	T1: Sec 8.2 – 8.4
4	Singular value decomposition with examples (using MATLAB) and applications (Face recognition with SVD) • SVD of a matrix (derivation) • Exemplify using matlab for a couple of matrices and also show that the singular values are arranged in descending order. • Face recognition example.	Class notes
5	Gauss elimination with scaling and partial pivoting; LU factorization and related methods • Gauss elimination (with and without scaling and partial pivoting). Take an example to shown the role played by precision. • LU factorization, Cholesky and Crout's methods with examples	T1: Sec 20.1, 20.2
6	Iterative methods of solving linear systems; Matrix eigenvalue problems and Power method for finding the dominant eigenvalue • Write Ax = b in the form (L+D+U) x = b and work out the iterative scheme for Gauss Jacobi and Gauss Seidel iterations. • Introduce vector and matrix norms (row sum, column sum and Frobenius norms) and work out a few problems in Excel / Matlab • Explain the power method and work out a couple of problems.	T1: Sec 20.3, 20.8
7 -8	Application of linear algebra in optimization. Modelling linear programming problem and the basics of Simplex algorithm and sensitivity analysis. • Model a LPP in construction of buildings. • Model the currency conversion optimization problem. • Work out the graphical method of solution in the case of 2 variable case • Simplex method for simple cases • Outline how Gauss Jordan produces the inverse matrix. • Graphical sensitivity analysis (Change in objective value coefficients and rhs of constraints)	Class notes
9	Calculus of one and several variables; Limits, continuity and	Class notes
	differentiability; Maxima and minima of functions; Steepest gradient method for finding the maximum. Constrained optimization (Lagrange multipliers) • Review limits, continuity and differentiability (graphically and algebraically) • Maxima and minima in one variable • Steepest gradient method • Lagrange multipliers (for more number of constraints)	

Evaluation Components (EC)

Evaluation Component 1 (EC1) Quizzes and Assignments	Evaluation Component 2 (EC2) Mid-Semester Examination *	Evaluation Component 3 (EC 3) Comprehensive Examination *
• Minimum weightage 20% • Individual or group assignments • Quizzes administered through LMS	• Minimum weightage 30% • Closed Book Exam, 120 minutes	• Minimum weightage 40% • Open Book Exam, 150 minutes

Note : * Indicates Mandatory Component

M.Tech. AIML
Programme Overview

M.Tech. AIML
Programme Overview

An Inter-disciplinary field comprising Computer Science and Engineering & Statistics

Machine Learning algorithms and Artificial Intelligence applications are the focus

Topics would span

Contemporary AIML techniques that drives the application applications in Natural Language Processing & other application areas

Algorithmic and computational techniques for AI system design, model building using curated data, implement machine learning techniques for handling large datasets and in resource constrained environments and applications

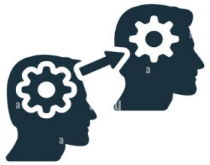
Curriculum

Strong foundation in mathematics, necessary statistical techniques

Computing techniques and algorithms for machine learning

Model development for a AI-driven application pipeline

M.Tech. AIML Specializations



Natural Language Processing

Deep Learning

General

Specialization Path

M.Tech. AIML
Programme Structure

Year	First Semester			Second Semester		
	Course No.	Course Title	Units	Course No.	Course Title	Units
I	AIML* ZC416	Mathematical Foundations for Machine Learning	4	AIML* ZG511	Deep Neural Networks	4
	AIML* ZC418	Introduction to Statistical Methods	4	AIML* ZG512	Deep Reinforcement Learning	4
	AIML* ZG557	Artificial and Computational Intelligence	5		Elective 1	
	AIML* ZG565	Machine Learning	4		Elective 2	
		Total	17		Total	16
II		Elective 3		AIML* ZG628T	Dissertation	16
		Elective 4				
		Elective 5				
		Elective 6				
		Total	16		Total	16

Please note:

Elective I	AIML* ZG530	Natural Language Processing ** #	4U
Elective III	AIML* ZG513	Advanced Deep Learning *** ##	4U

Handout Reference will be shared today after the orientation

** Indicate Courses under Natural Language Processing (NLP) Specialization
*** Indicate Courses under Deep Learning (DL) Specialization
# Indicate Mandatory Elective for NLP Specialization
Indicate Mandatory Elective for DL Specialization

Programme Overview for Natural Language Processing Specialization

Electives on the offer – Semester 2			
Mandatory Elective	AIML* ZG530	Natural Language Processing ** #	4U
1 more elective must be chosen from below offering so that minimum requirement of 16 units are met			
AIML* ZG537	Information Retrieval (course under NLP) **		4U
AIML* ZG516	ML System Optimization ***		4U
AIML* ZG517	Fair Accountable Transparent Machine Learning ***		4U
AIML* ZG526	Probabilistic Graphical Models		4U
AIML* ZG529	Data Management for Machine Learning		4U
AIML* ZG567	AI and ML Techniques for Cyber Security		5U

Please note:

Elective I	AIML* ZG530	Natural Language Processing ** #	4U
Elective III	AIML* ZG513	Advanced Deep Learning *** ##	4U

Electives on the offer – Semester 3		
4 electives must be chosen from below offering so that minimum requirement of 16 units are met		
AIML* ZG519	NLP Applications **	4U
AIML* ZG521	Conversational AI **	4U
AIML* ZG522	Social Media Analytics **	4U
AIML* ZG513	Advanced Deep Learning *** ##	4U
AIML* ZG514	Graph Neural Networks ***	4U
AIML* ZG515	Distributed Machine Learning ***	4U
AIML* ZG523	MLOps	4U
AIML* ZG525	Computer Vision	4U
AIML* ZG531	Video Analytics	4U
At least 3 courses under ** are **required** to be completed in semester 2 & 3 put together, including the mandatory elective for NLP specialization		

Note : The elective list is tentative and subject to change depending on the availability in the academic year
All the electives would be available to the students of specialization/General category in respective semesters only.
It is the student's responsibility to plan carefully for the registration in electives to become eligible for specific specialization.

Programme Overview for Deep Learning Specialization

Electives on the offer – Semester 2		
2 electives must be chosen from below offering so that minimum requirement of 16 units are met		
AIML* ZG530	Natural Language Processing ** #	4U
AIML* ZG537	Information Retrieval (course under NLP) **	4U
AIML* ZG516	ML System Optimization ***	4U
AIML* ZG517	Fair Accountable Transparent Machine Learning ***	4U
AIML* ZG526	Probabilistic Graphical Models	4U
AIML* ZG529	Data Management for Machine Learning	4U
AIML* ZG567	AI and ML Techniques for Cyber Security	5U

Please note:			
Elective I	AIML* ZG530	Natural Language Processing ** #	4U
Elective III	AIML* ZG513	Advanced Deep Learning *** ##	4U

Electives on the offer – Semester 3			
Mandatory Elective	AIML* ZG513	Advanced Deep Learning *** ##	4U
3 more electives must be chosen from below offering so that minimum requirement of 16 units are met			
AIML* ZG519	NLP Applications **		4U
AIML* ZG521	Conversational AI **		4U
AIML* ZG522	Social Media Analytics **		4U
AIML* ZG514	Graph Neural Networks ***		4U
AIML* ZG515	Distributed Machine Learning ***		4U
AIML* ZG523	MLOps		4U
AIML* ZG525	Computer Vision		4U
AIML* ZG531	Video Analytics		4U
At least 3 courses under *** are **required** to be completed in semester 2 & 3 put together, including the mandatory elective for DL specialization			

Note : The elective list is tentative and subject to change depending on the availability in the academic year
All the electives would be available to the students of specialization/General category in respective semesters only.
It is the student's responsibility to plan carefully for the registration in electives to become eligible for specific specialization.

Programme Overview for General Category

Electives on the offer – Semester 2		
2 electives must be chosen from below offering so that minimum requirement of 16 units are met		
AIML* ZG530	Natural Language Processing ** #	4U
AIML* ZG537	Information Retrieval (course under NLP) **	4U
AIML* ZG516	ML System Optimization ***	4U
AIML* ZG517	Fair Accountable Transparent Machine Learning ***	4U
AIML* ZG526	Probabilistic Graphical Models	4U
AIML* ZG529	Data Management for Machine Learning	4U
AIML* ZG567	AI and ML Techniques for Cyber Security	5U

Please note:			
Elective I	AIML* ZG530	Natural Language Processing ** #	4U
Elective III	AIML* ZG513	Advanced Deep Learning *** ##	4U

Electives on the offer – Semester 3		
4 electives must be chosen from below offering so that minimum requirement of 16 units are met		
AIML* ZG519	NLP Applications **	4U
AIML* ZG521	Conversational AI **	4U
AIML* ZG522	Social Media Analytics **	4U
AIML* ZG513	Advanced Deep Learning *** ##	4U
AIML* ZG514	Graph Neural Networks ***	4U
AIML* ZG515	Distributed Machine Learning ***	4U
AIML* ZG523	MLOps	4U
AIML* ZG525	Computer Vision	4U
AIML* ZG531	Video Analytics	4U

Note : The elective list is tentative and subject to change depending on the availability in the academic year
All the electives would be available to the students of specialization/General category in respective semesters only.
It is the student's responsibility to plan carefully for the registration in electives to become eligible for specific specialization.

M.Tech. AIML
Programme Overview

Faculty

- Experts drawn from industry
- Experts drawn from industry academia
- Expert Talk in select sessions/courses

Pedagogical Tools/Techniques

- Experiential learning
- Assignments, case studies, lab exercises
- Collaborative learning
- Group activities & exercises

Evaluation

- Quiz
- Lab, Assignments, Projects
- Mid semester exam
- End semester exam

Units and Courses	Quiz	Assignment	Mid Semester Exam	End Semester Exam	Total
4 Unit Courses	10	20	30	40	100
5 Unit Courses	5	25	30	40	100
4 Unit Courses	20	10	30	40	100

The above EC weightage is only for representational purposes.
Actual schedule & the list of electives may be different from this, subject to the design of the course by the lead instructor.

Program Operations
M.Tech. AIML

Program Timelines

Semester #	Semester Start	Semester End
Semester 1	November, 2024	April, 2025
Semester 2	May, 2025	October, 2025
Semester 3	November, 2025	April, 2026
Semester 4	May, 2026	October, 2026

Schedule - Lecture Sessions

- Classes will be held over weekends through online mode
- 5 Sessions / day
  - Session #1: 8:30 AM to 10:30 AM IST
  - Session #2: 10:40 AM to 12:40 PM IST
  - Session #3: 1:40 PM to 3:40 PM IST
  - Session #4: 3:50 PM to 5:50 PM IST
  - Session #5 06:00 PM to 08:00 PM IST
- Each course will be offered in multiple sections. Students will be allotted a section. As per our class schedule, in semester 1 all sections have classes on Saturday as well as Sunday (Cancelled sessions if any are likely to get scheduled on a weekday (Evening))
- Sessions will be recorded and automatically made available in Microsoft Teams account for later reference

Schedules - Tutorial, evaluation components

- **Tutorials / Webinar Sessions**
  - 4 sessions of 90 – 120 mins for each course
    - Recitation of topics, problem solving will be the focus of the sessions
    - Typically delivered by Teaching Assistants, attached to the course
    - On Tuesday / Wednesday/ Thursday from 7:00 PM to 8:30 PM or 09:00 PM
    - Sessions will be recorded and posted for later reference.
- **Mid Semester (120 Mins / course), Comprehensive Exams (150 Mins / course)**
  - Schedules to be announced at the beginning of semester
  - Exam may fall on **Friday**/Saturday/Sunday
- **Assignments & Quizzes**
  - To be announced through LMS for each courses. **No make-ups**.

People involved in the Course Delivery

- For Semesters – 1, 2, 3
- Instructor - in - Charge (IC) (Lead Faculty)
  - Leads the course delivery
- Instructors
- Learning Facilitators

Course led by IC			
Sec: Sat #1	Sec: Sat #2	Sec: Sun #1	Sec: Sun #2
Instructor #1	**Instructor #2**	**Instructor #3**	**Instructor #4**
Supported by Learning Facilitators			

Course Schedule
Semester 2 & Semester 3

Session #	Day 1	Day 2
1	Core Course	Electives
2	Core Course	Core Course
3	Electives	Electives
4		Core Course
5	Electives	Electives

Note :

- The above tentative schedule is only for use in demonstration. Finals schedule will be made available during the semester registration
- Desirable to plan for the specialization before the start of second semester course selections.
- Only **ONE** Specialization must be chosen by the students.
- No change request for consideration of specializations or change in specialization is allowed after this process.

Student's Preference Survey will be shared today after the orientation

Course Schedule
Semester 2 & Semester 3

- Semester #3
  - 9 electives
  - We do not guarantee that all four courses/sections of a student's choice can be scheduled in same day or in student requested sessions.

Code	Title	Saturday Slot #1 Saturday Slot #2	Sunday Slot #1
AIML* ZG514	Graph Neural Networks ***	2:00 PM [**GNN #1**]	No Sunday Section
AIML* ZG522	Social Media Analytics **	4:15 PM [**SMA #1**]	2:00 PM [**SMA #2**]
AIML* ZG519	NLP Applications **	No Saturday Section	2:00 PM [**NLPA #1**], 2:00 PM [**NLPA #2**]
AIML* ZG523	MLOps	2:00 PM [**MLOP #1**]	4:15 PM [**MLOP #2**]
AIML* ZG525	Computer Vision	2:00 PM [**CV #1**]	4:15 PM [**CV #2**]
AIML* ZG513	Advanced Deep Learning *** ##	2:00 PM [**ADL #1**]	8:45 AM [**ADL #2**]
AIML* ZG515	Video Analytics	4:15 PM [**VA #1**]	No Sunday Section
AIML* ZG515	Distributed Machine Learning ***	No Saturday Section	8:45 AM [**DML #1**]
AIML* ZG521	Conversational AI **	4:15 PM [**CA #1**]	No Sunday Section

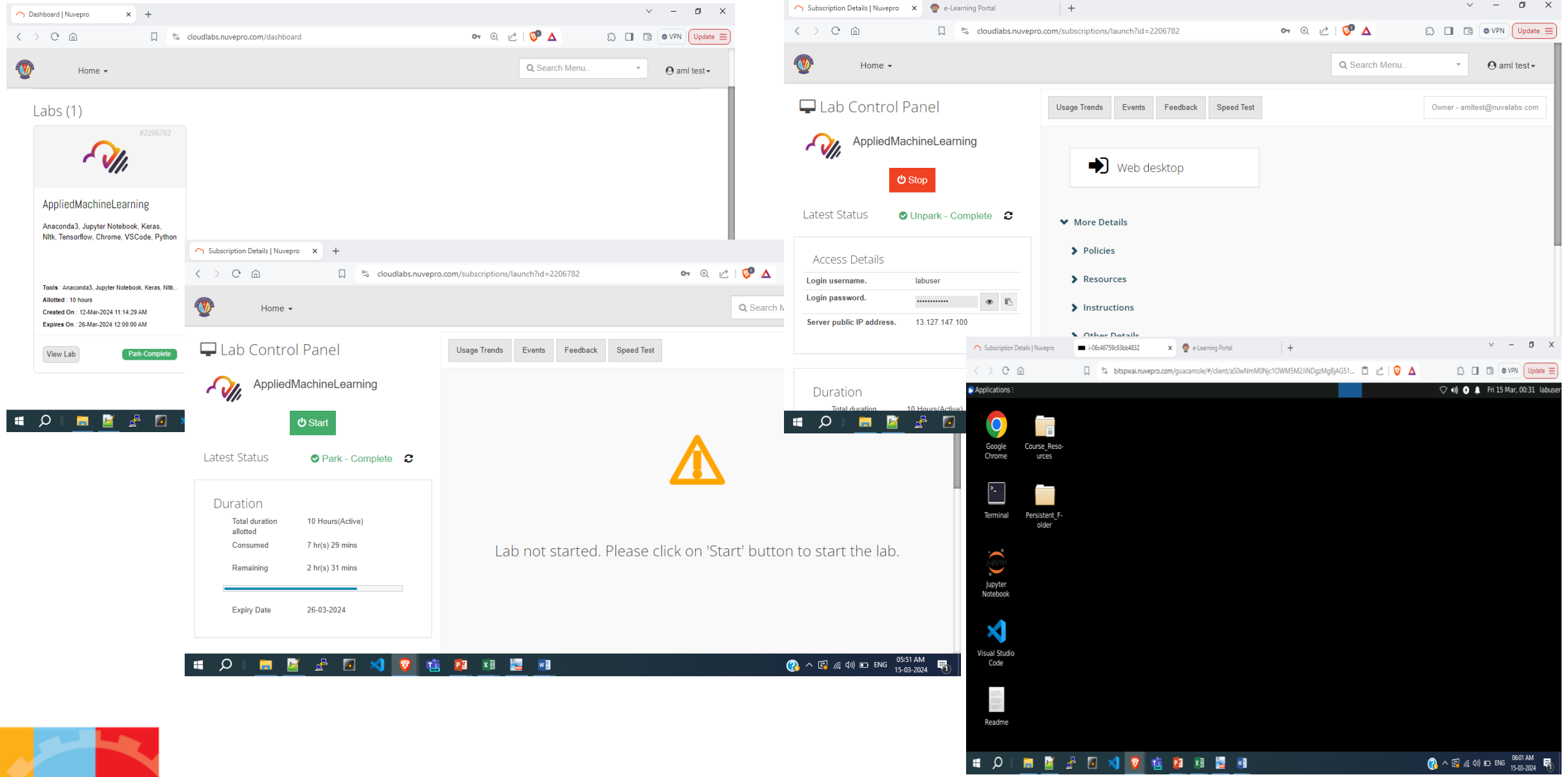
The above schedule is only for representational purposes for demonstrations.
Actual schedule & the list of electives may be different from this, subject to the availability in that academic semester.

Course Delivery

- Semester 4 - Dissertation
- No. of Units: 16
- 3 Interactions between Student and BITS Examiners

Detailed dissertation orientation will be conducted after the start of Third semester.

Virtual Lab / Remote Lab



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Operations Support

M.Tech. AIML

Formal Communication

- Communicate with the appropriate ones for quick resolutions.
- For Example:
  - Raise all queries on course contents, clarifications in the LMS discussion forums, messages to TA's, Instructors or IC's
  - Other course related concerns as emails to your Instructor / IC by email
  - Issues with LMS, matters related to access etc, issues with hall tickets, exam venues etc. to be mailed to WILP Support mail id
    - Queries raised here will be typically resolved in 48 - 72 hours

Formal Communication

- Formal BITS Notices will be delivered through LMS Announcements and Emails in BITS Email ID.
- Configure ***your BITS Email ID signature*** to carry the following details

  [Your Name as it appears on University Records]

  [Your Student ID - All Caps]

  M.Tech. (AIML) [2024 November Batch]

- Include relevant details when you initiate email communications with Instructors / IC's / and others in BITS.
  - For Ex: Mention your Section #, when you write to your IC.
- Always use BITS Email ID for all official communication

Whom to Contact for Support?

- **Programme Coordinators Contact:**
  - pc.aimlcluster@wilp.bits-pilani.ac.in
- **WILP Support Team Contact:**
  - support@wilp.bits-pilani.ac.in

Looping management team and campus faculty who are not direct stakeholder of your queries will not help in efficient resolution. The process of communication cycle will further be delayed in this case, as it might not reach the email bucket of SPOC on time. **AVOID** looping people/email ID who are not directly answerable to your queries.

Questions?

Program Orientation Session
M.Tech. AIML