EUROPEAN GLOBAL

Institute of Innovation & Technology

MS DATA SCIENCE AND AI

CURRICULUM

March 2024

Section A – General Information	
Name of the Education Provider	European Global

Section B – Overall Course Description		
Brief Profile of the Education Provider	European Global's vision is to enable every learner to be a co-creator of knowledge and be a meaningful and responsible contributor to the society. This can be done by promoting quality education. The key differentiation that EU GLOBAL aims to bring in are the following: 1. **Experiential Learning** in e-learning mode: EU GLOBAL faculty is an expert in designing content in self-paced study mode which is reflective and helps learners learn in active mode. 2. **Enhancing Skills & Employability**: EU GLOBAL pays special relevance to promote competency development as this enables lifelong employability in this era of exponential technology change. 3. **Research, Mentorship & Industry projects**: EU GLOBAL aims to promote research and projects mentored by industry experts in related fields of study to allow learners to implement their learning and possibly derive innovation in their field of study. 4. **Outcome based approach**: We integrate online residencies that can be visualised as online bootcamps with a resultant outcome. In addition, we promote action research via our evidence-based initiative which helps in integrating conceptual framework and reflecting to resolve practical problems encountered in the work environment. Please review this page https://europeanglobalvarsity.com/about-us/ EU GLOBAL has been structured very recently, and at present only markets the programs from its partner Universities. However, the website will be structured for offering its own qualifications post we have achieved Malta's program and institutional accreditation. We invite you to review our programs and we are optimistic, we shall be able to convince you already on our education quality.	
Type of Course	Qualification ☒	Award ☐

Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Title of the Qualification/ Award	Master of Science (M.S) in Data Science and Artificial Intelligence	
Proposed MQF Level	Level 7 (90 ECTS)	
Hours of Total Learning	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours	_____2250 for 90 ECTS _____ Hours	
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
	The program is intended to be delivered only in an online mode, with no mandatory on-campus contact hours required.	
Total Number of ECTS for Programme Completion	_____90_____ ECTS	
Mode of Attendance	Full-Time ☒	Part-Time ☒

Programme Duration	Full-Time: _____Weeks Full- Time:___12_____Months Full- Time: _____Years	Part-time: _____Weeks Part-time: __24-36_____Months Part time:_____Years
Target Audience	Ages 3 – 16 ☐ Ages 19 – 30 ☒ Age 65+ ☐	Ages 16 – 18 ☐ Age 31 – 65 ☒
Language/s of Instruction of Programmes	English	
Target Group	All learners who meet the eligibility requirement and are passionate to learn about evolving technologies are welcome to participate in their program. The target group for studying a Master of Science (M.S) in Data Science (DS) and Artificial Intelligence (AI) typically include the following: ● Working Professionals: Professionals with relevant work experience in data science, software engineering, or related fields who want to earn formal qualification in DS and ML. ● Data Scientists and Analysts: Professionals working in data-related roles who want to deepen their expertise in machine learning and AI techniques can benefit from an MS program to enhance their career prospects. ● Entrepreneurs and Innovators: Those looking to start AI and DS-related businesses or develop innovative AI applications can benefit from an MS program to acquire the necessary skills and knowledge. ● Researchers: Those interested in conducting research in DS, AI and ML may pursue these masters to gain the necessary skills and knowledge for their research endeavours. ● Top-level executives: Top-level executives who wish to understand the landscape of DS & AI to guide its implementation in the organisation.	
Address/es where programme will be delivered:	100% Online via our following e-campus https://campus.europeanglobalvarsity.com/	

Subject Area	More than one option possible: ☐ Generic programmes and qualifications ☐ Education ☐ Arts and Humanities ☐ Social Sciences, Journalism and Information ☐ Business, Administration and Law ☐ Natural Sciences, Mathematics and Statistics ☒ Information and Communication Technologies ☐ Engineering, Manufacturing and Construction ☐ Agriculture, Forestry, Fisheries and Veterinary ☐ Health and welfare ☐ Services

Relationship to Occupation/s

The learner who have successfully achieved the outcomes for this program can be employed for the following positions with following job descriptions:

Career Path	Job Description
Data Analyst	Forecasting future trends and identifying significant patterns in data. Also, Analysing massive datasets for anomalies, patterns, etc., to make predictions
Natural Language Processing Engineer	Investigating the relationship between spoken language and computer systems, working on chatbot and virtual assistant projects
Research Scholar	Pursuing Ph.D. in the areas of Data Science
Researcher	Engaging in AI and computer science research, advancing Data Science technologies
Research Scientist	Expert in computational statistics, machine learning, deep learning, and applied mathematics, typically requiring a doctorate
Software Engineer	Developing applications using AI tools, also known as a programmer or AI developer
AI Engineer	Creating AI models from scratch, assisting stakeholders in understanding outcomes
Machine Learning Engineer	Designing, developing, and maintaining ML software systems using data
Data Scientist	Assembling, scrutinising, and understanding data sets
Computer Vision Engineer	Creating and working on systems and projects using visual data

Entry Requirements	Following scanned copies of the documents are required to be provided to be admitted for the program ● Biopage of your valid passport. ● Bachelor's academic transcript and degree certificate in any discipline OR equivalent completion of Level 6 qualification with at least 180 ECTS. The applicant must have studied Mathematics at least MQF level 5 (Undergraduate Diploma/Certificate) or equivalent knowledge of mathematics (for instance, linear algebra, calculus). ● Language proficiency certificate: All programmes are taught in English language, and therefore English proficiency is required. For students who completed the bachelor's degree from the US, UK or any English-speaking countries, OR have studied in English Language for at least 2 years; OR have worked in an English speaking environment for at least 2 years prior to applying for this program, language proficiency certificate is not required. For learners who cannot provide any evidence of their English proficiency, they must provide an English language certificate equivalent to IELTS 6. ● 200-300 words Statement of Purpose/Motivational Letter ● Scan of passport size photograph

Overall Programme Description	Data Science and Artificial Intelligence has emerged as a discipline which emphasises the development of advanced data-driven computer programs that can access data and learn by themselves. This is aimed at removing human intervention in the most tedious of tasks. Irrespective of the industry, DS and AI have drastically altered the landscape and invented new ways of looking at the data. All are backed by standard statistical and mathematical principles. Masters in Science in Data Science and Artificial Intelligence offer students exactly what is needed to understand the world of data in tools and, in theory, machine learning and big data to enable students decision-making and analytics. Students will discover the concepts and gain expertise in the usage and applications of algorithms of Data Science and Artificial Intelligence. They will have abundant opportunities to plunge into advanced concepts. Through hands-on projects, students will gain experience on the concepts behind search algorithms, clustering, classification, optimization, reinforcement learning and other topics such as deep learning, computer vision, natural language processing techniques and incorporate the learning in Python. This programme would enable students to embrace the concepts of DS and AI and understand their extension to its application. Students will work on projects involving AI in healthcare, education, finance, manufacturing sectors etc.. Meticulously designed curriculum suitable to the industry needs with a high focus on practical applications. **Most Prominent Tools and Concepts:** Students will acquire a knowledge of DS and AI tools such as Matplotlib, Pandas, NumPy, Scikit-learn, TensorFlow, R etc., and concepts such as Data science and statistical concepts, Programming with Python, SQL, NoSQL, Artificial Intelligence, Machine Learning, Big Data, Natural Language Processing, Deep Learning, Computer Vision during the whole teaching and learning process.

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<td>Learning Outcomes for Knowledge obtained at the end of the programme</td>
<td>The learner will be able to:
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<tr><td>PA1</td><td>Demonstrate a deep understanding of core concepts in Data Science and Artificial Intelligence, including statistical modelling, machine learning algorithms, neural networks, big data technologies, natural language processing and computer vision.</td></tr>
<tr><td>PA2</td><td>Implement programming languages commonly used in data science and AI, such as Python and R, and be proficient in using relevant libraries and frameworks.</td></tr>
<tr><td>PA3</td><td>Develop expertise in data preprocessing, cleaning, and feature engineering to prepare data for analysis and modelling.</td></tr>
<tr><td>PA4</td><td>Design and develop research-based solutions for complex problems in data science, artificial intelligence and machine learning industry through appropriate consideration for the public health, safety, cultural, societal, and environmental concerns</td></tr>
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Learning Outcomes for Skills obtained at the end of the programme	The learner will be able to: PA5 – Design and implement machine learning models for various applications, such as classification, regression, clustering, and recommendation systems PA6 – Utilise tools like Matplotlib, Seaborn, and Tableau to create compelling visualisations that aid in decision-making processes. PA7 – Apply NLP and computer vision techniques to process and analyse human language data, image recognition, object detection, and image generation tasks. PA8 – Apply theoretical knowledge and work on capstone projects that showcase the ability to solve complex problems using data science and AI methodologies.

General Pedagogical methods used for this programme	**Concept for the use of teaching aids** To promote learning in accordance with the desired levels of the further higher education framework, EU GLOBAL uses modern teaching aids to facilitate learning such as flipped classrooms where learners are provided content access to pre-read to allow better understanding and promote engaging discussions on application of the concept. Active learning strategies are adopted to ensure development of cognition of learners so that they develop analytical, critical thinking and creative skills. The following are key teaching aids employed within our didactic model: 1. **Personality Test** - The goal of the MBTI is to allow respondents to further explore and understand their own personalities including their **likes, dislikes, strengths, weaknesses, possible career preferences, and compatibility with other people**. This survey is conducted via Truity (https://www.truity.com/) for all our new admissions. This reflationary exercise helps the mentors and students set the expectations and targets for self-development for the further academic duration of study. 2. **Learning Resources:** 1. Case Studies: Case studies from Harvard and other sources, and caselets like daily business news set the base for almost every course. Case studies help in review of real-life scenarios and the way a conceptual framework is related to real-life scenarios to provide solutions and recommendations. 2. Simulations: A simulation helps students imitate the real-life scenario, and to take probabilistic decisions to witness the results in terms of efficiency of the decision. 3. Research papers: Literature and conclusions derived from research papers is a very important source of learning from other scholars. These provide wider perspective and apprises of what have been already researched in the field of study. 4. Books: Books are an essential source of study to learn concepts in a systematic manner and to practise exercises. 5. Audio-video learning: Audio-video learning has been considered as one of the imperative tools that suits well with varied learning personalities. It includes podcasts, videos from Professors, documentaries from BBC, etc. 6. Research Projects: Seminars aim to thoughtfully design research activities such as surveys, etc so that students can learn primary research to investigate a business problem. 7. Miscellaneous activities: We promote innovation which every faculty brings. The faculty is advised to prepare academic delivery in an engaging manner. They are motivated to bring in activities like role-plays, presentations, etc.

	3. **Use of Technology:** EU GLOBAL has a very well-developed Learning management system which is instrumental in exchange of information between the School's administration, faculty and the students. Each student will be provided an access to our learning management system from day 1 of their enrolment. The system will have the following key components: 1. Induction - the induction module is called "Student Services" which allows access to all the School's regulations and policies, where students can ask questions, academic writing resources, and all essential information that are instrumental in getting the students to start with us. 2. Course-wise Resources – All the information, and learning resources related to the chosen courses are provided via our learning management system. This provides better communication. 3. Assessments – The students are required to upload all submission-type assessments via the learning management system. 4. **Career Coaching and Academic** Coaching – The students are also provided additional modules to enhance employability via our learning management system.

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<td>Selection Criteria for Tutors/Lecturers for this programme:</td>
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Responsible course director and academic director of the Master's programme

● Minimum Masters Degree in Data Science or related field
● Relevant Professional experience Minimum 10 Years
● PhD Preferred

Course Faculty:
● Minimum Master Degree MQF7 / PhD Preferred

● Professional experience in Minimum 2 Years with PhD/ OR 5 years with Masters degree.

● Teaching experience in an academic environment

● capability to manage academic delivery via Online Campus

● capability of recording interactive learning by videos and PowerPoints

<u>Support to students provided</u>

● Online via e-campus
● Email, WhatsApp and phone
● Video Conference System
● During workshops and placements
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<td>Tutors/Lecturers</td>
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<tr><td>Statistics for Data Science</td><td></td><td>Mr. Abhay Sharma</td></tr>
<tr><td>Mathematics for Data Science</td><td></td><td>Dr. Marco Javorone</td></tr>
<tr><td>Programming for Analytics using Python</td><td></td><td>Mr. Kosmos and Mr. Abhay Sharma</td></tr>
<tr><td>Data Visualization and Storytelling with Tableau</td><td></td><td>Dr. Anurag Singh</td></tr>
<tr><td>Artificial Intelligence and Machine Learning</td><td></td><td>Dr. Marco Javorone</td></tr>
<tr><td>Machine Learning Methods using Python</td><td></td><td>Mr. Abhay Sharma</td></tr>
<tr><td>Convolutional and Recurrent Neural Networks</td><td></td><td>Dr. Tunde Adegbola and Ms. Premlatha T</td></tr>
<tr><td>Computer Vision and Image Recognition</td><td></td><td>Prof. Laszlo</td></tr>
<tr><td>Natural Language Processing</td><td></td><td>Ms. Premlatha T</td></tr>
<tr><td>Big Data and NoSQL</td><td></td><td>Prof. Dr. Ramanathan Sakravarthy</td></tr>
<tr><td>Data Warehousing and management</td><td></td><td>Mr. Yugandhar</td></tr>
<tr><td>Research Methods</td><td></td><td>Dr. Kanika Gupta</td></tr>
<tr><td>Capstone Consulting Project</td><td></td><td>Dr. Kanika Gupta and subject specific supervisors</td></tr>
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General Assessment Methods	We follow continuous and end of the module assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. The report can be a project, analysis, case study, research paper, etc. We also integrate formative assessment which does not contribute to the final grade, rather helps in peer to peer learning and reflecting on the concepts used.

Section C – The Programme Structure: *CURRICULUM – MS DATA SCIENCE AND AI*

Module/Unit Title	Compulsory (C) or Elective (E)	ECTS	MQF Level of each module	Mode of Teaching	Mode of Assessment
Statistics for Data Science	C	6	7	Each course comprises 8-10 units. Each unit contains recorded lectures, PowerPoint, supplement reading material such as research paper, report, book, etc. Live Sessions will be scheduled, their recordings will be provided however not compulsory to attend live	Each Unit contains continuous assessment in the form of multiple-choice questions with a weight of 40%, and each course will have a final project weighing 60%.
Mathematics for Data Science	C	6	7		
Programming for Analytics using Python	C	6	7		
Data Visualization and Storytelling with Tableau	C	6	7		
Artificial Intelligence and Machine Learning	C	6	7		
Machine Learning Methods using Python	C	6	7		
Convolutional and Recurrent Neural Networks	C	6	7		
Computer Vision and Image Recognition	C	6	7		
Natural Language Processing	C	6	7		
Big Data and NoSQL	C	6	7		
Data Warehousing and management	C	6	7		
Research Methods	C	6	7		
Capstone Consulting Project	C	18	7		
Total ECTS Requesting Accreditation		**___90_____ ECTS**			

Total ECTS for Programme Completion	**____90____ ECTS**

Exit Awards/Qualifications

Should the programme contains any Exit Point/s kindly specify:
- the full name of each Exit Award/ Qualification
- the MQF level,
- number of ECTS and
- list the modules leading to each Exit Award/Qualification

This information shall be provided for each Exit Point.

1. Post-Graduate Diploma in Data Science & Artificial Intelligence (MQF level 7/60ECTS)

Sr. No.	MS in Data Science & AI - revised programme structu	ECTS
1	Statistics for Data Science	6
2	Mathematics for Data Science	6
3	Programming for Analytics using Python	6
4	Data Visualization and Storytelling with Tableau	6
5	Artificial Intelligence and Machine Learning	6
6	Machine Learning Methods using Python	6
7	Convolutional and Recurrent Neural Networks	6
8	Computer Vision and Image Recognition	6

Capstone Consulting Project 12 Credits

Duration: 9-24 months
The students can complete this qualification- Post-Graduate Diploma in Data Science & Artificial Intelligence in 9m by studying for around 30-40 hours per week. However, if you aim to study 15-25 hours per week, please expect a longer time period to complete, which is 24 months. The minimum time to complete this program is 9m and the maximum time to complete this program is 24m.

2. Post-Graduate Certificate in Data Science (MQF Level 7/30ECTS)

Sr. No.	MS in Data Science & AI - revised programme structu	ECTS
1	Statistics for Data Science	6
2	Mathematics for Data Science	6
3	Programming for Analytics using Python	6
4	Data Visualization and Storytelling with Tableau	6
5	Artificial Intelligence and Machine Learning	6

Duration 4 -12 months

	The students can complete this qualification- Post-Graduate Certificate in Data Science in 4 m by studying for around 30-40 hours per week. However, if you aim to study 15-25 hours per week, please expect a longer time period to complete, which is 12 months. The minimum time to complete this program is 4m and the maximum time to complete this program is 12m. 3. **Micro-credentials:** a. Award in Statistics for Data Science (MQF Level 7/6ECTS) (Duration:5-10 weeks) b. Award in Mathematics for Data Science (MQF Level 7/6ECTS) (Duration:5-10 weeks) c. Award in Programming for Analytics using Python (MQF Level 7/6ECTS) (Duration:5-10 weeks) d. Award in Data Visualization and Storytelling with Tableau (MQF Level 7/6ECTS) (Duration:5-10 weeks) e. Award in Artificial Intelligence and Machine Learning (MQF Level 7/6ECTS) (Duration:5-10 weeks) f. Award in Machine Learning Methods using Python (MQF Level 7/6ECTS) (Duration:5-10 weeks) g. Award in Convolutional and Recurrent Neural Networks (MQF Level 7/6ECTS) (Duration:5-10 weeks) h. Award in Computer Vision and Image Recognition (MQF Level 7/6ECTS) (Duration:5-10 weeks) i. Award in Natural Language Processing (MQF Level 7/6ECTS) (Duration:5-10 weeks) j. Award in Big Data and NoSQL (MQF Level 7/6ECTS) (Duration:5-10 weeks) k. Award in Data Warehousing and management(MQF Level 7/6ECTS) (Duration:5-10 weeks) l. Award in Research Methods (MQF Level 7/6ECTS) (Duration:5-10 weeks) Duration of microcredentials note - 5-10 weeks

The students can complete this qualification of micro-credentials of MQF Level 7/ 6 ECTS) in 5 weeks by studying for around 30-40 hours per week. However, if you aim to study 15-25 hours per week, please expect a longer time period to complete, which is 10 weeks. The minimum time to complete this program is 5 weeks and the maximum time to complete this program is 10 weeks

4. **Master of Science(MS) in Data Science and AI (Top Up)** **(MQF Level 7/30ECTS)**

Statistics for Data Science	6
Research Methods	6
Capstone Consulting Project	18

Entry-criteria:
The learners who have completed Level 7 Post-Graduate Diploma in Data Science & Artificial Intelligence can opt to enter into Top-up Master of Science (MS) in Data Science & Artificial Intelligence and complete further 30 ECTS to be awarded the Master's degree - Master of Science (MSc) in Data Science & Artificial Intelligence.

Duration: 6-12 months

The students can complete this qualification of MQF Level 7/ 6 ECTS) in 6 months by studying for around 30-40 hours per week. However, if you aim to study 15-25 hours per week, please expect a longer time period to complete, which is 12 months. The minimum time to complete this program is 6 months and the maximum time to complete this program is 12 months.

Structure of Programme

If the programme has a duration of more than one semester, a structure of how the modules shall be divided per semester and academic year has to be provided.
If the programme has both Full-time and Part-time duration, the structure shall take into consideration both modes of attendance.

The program is offered in online mode with rolling monthly admissions and project -based individual assessment.

Each module is expected to be completed in 5 weeks when studied full-time, and 8-10 weeks when studied part-time. The full-time and part-time modes will follow the same structure, the only difference will be related to weekly learning hours spent as stated in the duration in the above section..

Sem 1	Statistics for Data Science	6
	Mathematics for Data Science	6
	Programming for Analytics using Python	6
	Data Visualization and Storytelling with Tableau	6
	Artificial Intelligence and Machine Learning	6
	Machine Learning Methods using Python	6
Sem 2	Convolutional and Recurrent Neural Networks	6
	Computer Vision and Image Recognition	6
	Natural Language Processing	6
	Big Data and NoSQL	6
	Data Warehousing and management	6
Sem 3	Research Methods	6
	Capstone Consulting Project	18

Section D – The Programme Structure

Title of the Module/Unit	1. **Statistics for Data Science**

Module/Unit Description	The course focuses on developing statistical thinking to set a foundation of various specialisation courses in their future course of study. It involves introduction to the statistical concepts and tools widely used for Data Analysis and helps in effective decision making. Statistical knowledge develops and extends the conceptual knowledge of students to infer noteworthy results/findings. Students will be given an opportunity to work through sample data as well as the theoretical principles, tools, and procedures of statistics.
Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Develop a strong foundation in statistical concepts and methods relevant to AI and ML applications 2. Implement linear regression, logistic regression, and other regression/classification algorithms for specific AI tasks. 3. Evaluate and recommend the use of descriptive statistics, probability, confidence intervals, hypothesis testing, analysis of variance, regression and correlation analysis, t-tests, and technological applications for statistical analysis, as well as the interpretation of the relevance of statistical findings for solving real-life problems and making decisions.
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Understand and evaluate complex statistical concepts such as multivariate analysis, advanced probability distributions, hypothesis testing, time series and advanced regression techniques. Make statistical, graphical, and algebraic approaches usable when appropriate. 2. Evaluate various methods of collecting and sampling data, including stratified sampling, cluster sampling, and non-probability sampling methods. 3. Evaluate and fine-tune machine learning models for optimal performance using statistical analysis to solve real life problems.

	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Implement numerical and quantitative analysis-based recommendations in data science. 2. Construct relevant judgement for appropriate use of statistical, graphical, and algebraic approaches when required 3. Analyse the underlying presumptions of analytical tools critically 4. Summarise and interpret statistical data in order to address real-world issues.
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Critically examine the applications and constraints of statistical analysis. 2. Employ technology for statistical analysis and problem solving after successfully completing the course.

	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel 15. Data Analysis: Advanced proficiency in analysing large datasets, identifying patterns, and extracting insights using statistical and machine learning techniques. 16. Statistical Analysis: Understanding how to analyse data using techniques like hypothesis testing and regression analysis. 17. Probability Theory: Learning about probability distributions and random variables. 18. Data Manipulation: Acquiring skills to clean, preprocess, and manipulate data using tools like R or Python. 19. Data Visualization: Creating informative charts and graphs to explore and present data effectively. 20. Sampling Techniques: Understanding different methods for selecting samples from a population.	
Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	

Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:**

	Unit 1: Data and Presentation of Data Introduction: Introduction to statistics, Meaning and scope, Limitation of Statistics, Data, Types of data, Methods of data collection, Presentation of data, Tabulation, Frequency Distribution, Graphical Representation **Unit 2:** Define inferential and descriptive statistics Descriptive Statistics. Measures of Central Tendency and Dispersion, Measure of Central Tendency - Mean, Median, Quartiles, Deciles, Percentiles, Mode, Geometric mean, Harmonic mean. Measure of dispersions – Introduction to Range, Mean Deviation, Quartile Deviation, Variance, Standard Deviation, Coefficient of variation, Skewness, kurtosis **Unit 3:** Scatter Diagram, Positive and Negative Correlation, Limits for Coefficient of Correlation, Karl Pearson' Coefficient of Correlation, Spearman's Rank Correlation. (Ranks are not equal only) Regression Analysis: Concept Least Square Fit of a Linear Regression, Two Lines of Regression, Properties of Regression Coefficients (Simple problems only) **Unit 4:** Introduction to probability. Concepts – Random Experiment, Sample Space – Definitions of Probability, Law of probability. Distributions and Sampling method- Discrete and continuous probability distributions: Poisson's, Binomial, Normal distribution curves and characteristic. **Unit 5:** Time series analysis: Utility of time series, Components of time series, Time series models-Addition and Multiplication model, Measurement of trend- Graphic method, moving average methods, Method of least squares, fitting a straight-line trend, seasonal variations-Estimation of seasonal variations, Method of simple average, ratio to trend method, ratio to moving average method, cyclical variations. Limit theorems - Chebyshev's inequality, Weak Law of Large Numbers, Central Limit Theorems **Unit 6:** Sampling distributions and making inferences about population parameters- Concepts of statistic, parameter and estimate calculation, sampling distribution and standard error. Estimating the population mean by using z-statistic and t- statistic (for sigma known and unknown), Estimating the population proportion and variance. **Unit 7:** Point estimation: Concepts of parameter, random sample and its likelihood. Properties of estimators. Sufficiency, Factorization theorem, Minimum variance unbiased estimator Methods of estimation-maximum likelihood and method of momentsInterval estimation: Concepts of confidence interval and confidence coefficient, confidence interval for mean, difference between means, variance and ratio of variances under normality. Large sample confidence interval for proportions and correlation coefficients

	Unit 8: Hypothesis Testing – Introduction to hypothesis testing. Defining the null and alternate hypothesis Construct hypothesis tests. Distinguish between Type I and Type II errors. Determine strength of decision by p-value. Testing hypothesis on Population mean by z and t statistics. Testing hypothesis about a proportion and variance. Analysing the differences in two populations for various cases. **Unit 9:** ANOVA – Analysis of variance Introduction to design of experiments. Completely randomised design (One-way ANOVA). Multiple comparison tests. Randomised Block Design, A Factorial Design (Two-way ANOVA) **Unit 10:** Non-Parametric Statistics and Test Methods. Chi-Square Analysis, Chi-square goodness of fit Test. Analysing data using Nonparametric statistics – Runs Test, Mann-Whitney U Test, Wilcoxon Matched pairs Signed Rank Test.
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	**Core Reading List** 1. Statistics for Data Science, James D. Miller, Packt Publishing Limited, 2017 **Supplementary Reading List** 1. Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python, Peter Bruce, Andrew Bruce, Peter Gedeck, Second Edition, Shroff/O'Reilly, 2020 2. Essential Maths for Data Science: Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics, Thomas Nield, First Edition, Shroff/O'Reilly, 2022 3. Statistics for Machine Learning, Pratap Dangeti, Packt Publishing, 2017 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**2. Mathematics for Data Science**
Module/Unit Description	Mathematics for Data Science is a foundational course that provides essential mathematical concepts and techniques required for understanding and analysing data in various fields such as statistics, machine learning, and data analysis. Understanding these mathematical concepts and techniques provides a solid foundation for tackling real-world data science problems and developing effective solutions. This course comprehensively addresses foundational principles essential for entry into the realm of data analytics, integrating both theoretical frameworks and practical applications. It functions as a foundational stepping stone for individuals seeking to engage with data, catering particularly to novices in the field.

Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Demonstrate a strong foundational understanding of key mathematical concepts relevant to data science. 2. Apply linear algebra concepts to perform operations on data, transform feature spaces, and understand linear transformations in machine learning.
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Apply optimization principles to train machine learning models effectively and fine-tune algorithm parameters. 2. Formulate real-world problems into mathematical models suitable for analysis and interpretation in a data-driven context.. 3. Utilise discrete mathematics in algorithm design, network analysis, and decision-making processes in data science. 4. Apply differential equations to model dynamic systems and time-dependent processes commonly encountered in data science applications.
	Skills:

	At the end of the module/unit the learner will have acquired the following skills: 1. Apply linear algebra to solve problems related to data transformation, dimensionality reduction, and machine learning algorithms 2. Apply calculus concepts to optimise functions, understand rates of change, and interpret gradients in the context of data science. 3. Develop the ability to translate practical challenges into mathematical models suitable for data-driven analysis
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Critically examine the applications and constraints of topics covered in the course. 2. Employ technology for statistical analysis and problem solving after successfully completing the course.
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer

Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Operations with Vectors, Basis, vector space, linear independence

	Unit 2: Matrix Transformation, Gaussian Elimination, Inverse Matrices Determinants **Unit 3**: Introduction : Einstein summation convention, Symmetry of Dot Product, Orthogonal matrices, The Gram–Schmidt process **Unit 4:** Matrix Decomposition, Cholesky Decomposition, Eigen Decomposition and Diagonalisation **Unit 5:** Partial differentiation of gradients, Gradients of vector valued functions, Gradients of Matrices **Unit 6:** Unconstrained optimization, Linear optimization, convex quadratic optimization, second order cone optimization, semidefinite optimization, convex composite optimization **Unit 7:** Gradient descent methods, Newton method, interior point methods, active set, proximity methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient descent, Maximum likelihood, Bayesian estimation for Machine Learning
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	**Core Reading List** 1. Essential Maths for Data Science: Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics, Thomas Nield, Shroff/O'Reilly, 2022 **Supplementary Reading List** 1. Mathematics of Data Science: A Computational Approach to Clustering and Classification, Daniela Calvetti, Erkki Somersalo, Society for Industrial & Applied Mathematics,U.S. 2021 2. Before Machine Learning - Volume 1: Linear Algebra -The Fundamental Mathematics for Data Science and Artificial Intelligence, Jorge Brasil, Shroff/Jorge Brazil; First Edition, 2023 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general fundamental, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**3. Programming for Analytics using Python**
Module/Unit Description	The course allows students to gain an in-depth understanding of programming in Python for data analytics. Students slowly gain pace by creating a variety of basic scripts and gradually pick up advanced features with each of the course modules designed meticulously. The course will allow students to explore the large and multi-faceted Python libraries to solve a wide variety of data analytics and data visualisation problems.

Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Understand the basics of Python programming language 2. Utilise fundamental programming constructs such as variables, data types, loops, and conditionals. 3. Acquire skills in using Python libraries for data manipulation and analysis, such as NumPy and pandas
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Apply data cleaning techniques to handle missing data and outliers. 2. Perform exploratory data analysis (EDA) using statistical and visual methods 3. Connect to databases using Python. 4. Develop Python applications, interact with APIs, work with external data sources, and create interactive user interfaces, expanding your ability to build practical and versatile programs.
	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Apply acquired skills to a real-world analytics project. 2. Understand and apply coding best practices for writing clean, readable, and efficient code. 3. Enhance critical thinking by analysing data and making informed decisions based on analysis results.

	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Acquire proficiency in understanding and implementing Python's syntax, including variables, data types, loops, conditional statements, and functions. 2. Develop the ability to explore datasets visually to identify patterns, outliers, and correlations that might not be apparent in tabular data. 3. Learn how to import data from various sources (CSV, Excel, databases), clean and preprocess data by handling missing values, duplicates, and outliers.	
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel 15. Python	
Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours

	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:**

	Unit 1: What can python do?, Why python?, Python working environment (Jupyter, anaconda), Python syntax compared to other programming languages, Python install **Unit 2:** Print statement, Comments, Python data types and variables, String operations in Python, Simple input & output, Simple output formatting, Operators in Python, Lists and dictionaries **Unit 3:** List comprehensions, Nested list comprehensions, Dictionary comprehensions, Default parameters, Variable arguments, Specialised sorts **Unit 4**: Reading and importing various data file, File types in python, Handing a single exceptions, Handling multiple exceptions, The with statement, Writing & appending to files **Unit 5:** Basic properties and operation of the series, Data frame objects,Usage of main libraries of python, Pandas, numpy and seaborn, Data sub setting methods **Unit 6:** Data transformation, String manipulation, Basic of data aggregation, Merging and subsetting data sets, GroupWise operations and transformations, Aggregation by using pivot tables and crosstabs, Slicing, Dicing, Indexing operations **Unit 7:** Manipulate and visualise time series data, Indexing time series, reading and slicing times, resampling time-series data, method chaining and filtering **Unit 8**: Dealing with Missing Values, Data Formatting, Normalisation and binning **Unit 9:** Describing the various packages for visualisation in Python, Creating basic data plots as line plots, scatter plots, bar plots with matplotlib and Pandas, Customising the plots. Advanced data visualisation, Parallel coordinates plots, Correlation plots statistical characterization of the plots, Python visualisation Tool Ecosystem **Unit 10:** Basic plotting, Layouts, interactions and annotations, Building interactive dashboards/apps

Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.
Reading List	**Core Reading List** 1. Learning Python: Powerful Object-Oriented Programming 2013 English edition by Mark Lutz **Supplementary Reading List** 1. Python for Data Science for Dummies, 2ed, Luca Massaron John Paul Mueller, Wiley, 2020 2. Data Analytics using Python, Bharti Motwani, Wiley, 2020 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**4. Data Visualization and Storytelling with Tableau**

Module/Unit Description	The foundations of good data-driven storytelling will be covered in this course. The skills that students acquire will enable them to convey data findings in visual, oral, and written contexts to a variety of audiences and the public. The associated tools will be introduced to the class. Students learn the abilities needed to be proficient Data Storytellers on this course. They will learn where to obtain and download datasets, how to mine those databases for information, and how to present their findings in a variety of forms. Through visual data analysis, students will learn how to "connect the dots" in a dataset and identify the narrative thread that both explains what's happening and draws their audience into a tale about the data. Additionally, students will learn how to convey data stories in various ways to various stakeholders and audiences.

Learning Outcomes **Applying Knowledge and Understanding: apply, practice, demonstrate, show, plan, design, operate, assemble, use, construct, prepare, create, compose, arrange** **(Example of learning outcome structure: Action Verb + Object + Context** **Apply principles of good practice to dispense, supply and administer medicinal products and other activities in a pharmacy.)**	**Competences:** At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Experiment with various datasets and create amazing graphs with Tableau, creating fascinating stories with the data's hidden information 2. Use Tableau's array of resources to show best practices for data narrative and visualisation 3. Discover the benefits and drawbacks of each graph and see how simple it is to create geographical maps using Tableau **Knowledge:** At the end of the module/unit the learner will have been exposed to the following: 1. Understand Data Visualization, Tools for Data Visualization, Features and uses of Tableau, Installing Tableau, features of Tableau. 2. Collect and customise data to build basic graphs manually and built in options. 3. Filter, sort and group the data to create hierarchies, working with date fields, dual axis and combined-axis charts and employ aggregation methods and advanced plots. 4. Analyse extracted data by joining tables with/without calculations in Tableau, blending multiple data sources, use of sets and context filters for advanced plots, build level of detail expressions, create and use parameters in the plots. 5. presenting distributions using histogram, box and whisker plots, build bar-in-bar and bullet charts for goal comparison. 6. Employ statistical and forecasting features of Tableau for adding trend and reference lines and generating a forecast. 7. Create appealing dashboards using design techniques and filter actions. **Skills:**

	At the end of the module/unit the learner will have acquired the following skills: 1. Understand and learn the importance and process of data visualisation using Tableau 2. Learn advanced features of Tableau using data calculations to enhance the visualisations 3. Understand how inherent calculations of Tableau function and alter the charts 4. Build advanced & customised dashboards
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Utilise Tableau to visually analyse datasets. 2. Use Tableau to create static charts, interactive dashboards, and data stories. 3. Describe the significance of communication abilities and talents for those working as data analysts. 4. Become a data-driven visual storyteller to show trends, patterns, and insights in the best possible way. 5. Present data insights clearly and persuasively in a variety of media, including oral presentations, written reports, and interactive visualisations. 6. Create expert business reports and deliver persuasive client presentations

<table>
<tr><td></td><td colspan="2">Module-Specific Digital Skills and Competences
At the end of the module/unit, the learner will be able to

1. Dealing with different learning platforms
2. Use of the Office package or comparable office software
3. Creating online presentations
4. Independent online search on the Internet
5. Use of various video conferencing systems
6. Scan, print and upload online
7. Working with e-book readers
8. Using plagiarism software
9. Online peer-to-peer Collaboration
10. Communicating via WhatsApp, Skype Teams etc.
11. Independent organisation of student InterVision meetings based on various online platforms
12. Dealing with citation software
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15. Tableau</td></tr>
<tr><td rowspan="2">Hours of Total Learning for this Module/Unit</td><td>Total Contact Hours</td><td>Supervised Placement and Practice Hours</td></tr>
<tr><td>Self-Study Hours</td><td>Assessment Hours</td></tr>
<tr><td>Total Learning Hours of this Module</td><td colspan="2">_____150_____ Hours</td></tr>
<tr><td rowspan="2">Mode of Delivery

Kindly tick a box, as applicable</td><td>Fully Face-to-Face Learning ☐</td><td>Blended Learning ☐</td></tr>
<tr><td>Fully Online Learning ☒</td><td>Work Based Learning ☐</td></tr>
</table>

Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	We intend to offer programs in online model, hence our online didactic model is as follows: Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Getting Started & Introduction to Data Visualization, Tools for Data Visualization, Features and uses of Tableau, Installing Tableau, features of Tableau.

	Unit 2: Connecting to data, customising a data source. Build basic graphs manually and built in options. **Unit 3:** Filtering, sorting and grouping the data. Creating hierarchies, working with date fields, dual axis and combined-axis charts. Aggregation methods and advanced plots. **Unit 4:** Working with conversion functions. Geographical analysis by plots. Using quick table calculations and creating calculated fields to be used in plots. **Unit 5:** Working with data extract. Joining tables with/without calculations in Tableau. Blending multiple data sources. Use of sets and context filters for advanced plots. **Unit 6:** Build Level of detail expressions, create and use parameters in the plots. Advanced mapping – Modifying locations, Customizing Tableau's Geocoding **Unit 7:** Viewing distributions using histogram, box and whisker plots. Build bar-in-bar and bullet charts for goal comparison **Unit 8:** Use of statistical and forecasting features of Tableau for adding trend and reference lines and generating a forecast. Create appealing dashboards using design techniques and filter actions **Unit 9:** Custom Table Calculations, Secondary Table Calculations, Pareto Charts and Secondary Calculations. Time-based data analysis with Sparklines, Slope charts and control charts **Unit 10:** Refine the dashboards, add context filters and navigation pages. Storytelling with Tableau with the help of visual analytics and informative & appealing graphs in Tableau
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	**Core Reading List** 1. Data Visualization with TABLEAU: Learn Data Visualization, Charts, Dashboard and Storytelling with Tableau, Praveen Kumar, Gurucool Publishing, 2020 **Supplementary Reading List** 1. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, Ryan Sleeper, Shroff/O'Reilly, 2018 2. Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software (2nd Edition) By Daniel Murray, 2016 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**5. Artificial Intelligence and Machine Learning**

Module/Unit Description	This course widely covers contemporary topics in Artificial Intelligence, primarily – Machine learning. It deeply focuses on the core concepts of supervised and unsupervised learning. Learners will learn the popular Machine Learning algorithms and techniques. The exercises after each unit will extend the applications of machine learning concepts to a range of real-world problems. This course will focus on related topics like machine learning, deep learning and their applications and solutions. Learners shall be able to acquire the ability to design intelligent solutions for various business problems in a variety of domains. Throughout the course, emphasis will be placed on both theoretical understanding and practical implementation of machine learning algorithms. By the end of the course, students will have gained a solid understanding of the fundamental concepts and techniques of machine learning and will be well-prepared to apply them to real-world problems.
Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Define and explain the fundamental concepts, principles, and applications of ML. 2. Implement and evaluate various supervised learning algorithms, such as naive bayes, linear regression, decision trees, and support vector machines. 3. Explore unsupervised learning techniques, including clustering and dimensionality reduction. 4. Apply algorithms like k-means clustering and principal component analysis (PCA).
	Knowledge:

	At the end of the module/unit the learner will have been exposed to the following: 1. Grasp the foundational concepts of ML, subfield of Artificial Intelligence (AI), including its significance, capabilities, and inherent limitations. 2. Evaluate the performance of ML models using metrics such as accuracy, precision, recall, and F1 score. 3. Learn techniques for hyperparameter tuning to optimise model performance. 4. Apply ML techniques to real-world problems and datasets. 5. Analyse case studies and understand the practical challenges of implementing AI solutions.
	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Design and implement various machine learning algorithms in a range of real-world applications 2. Understand and implement various tools and techniques of Artificial Intelligence 3. Understand the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning 4. Demonstrate proficiency in applying scientific method to models of machine learning

	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Design and develop intelligent solutions to problems in their application domain 2. Implement various machine learning and deep learning algorithms for applications 3. Demonstrate fundamental understanding of artificial intelligence (AI) and expert systems	
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel 15. Python	
Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	

Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:**

	Unit 1: Foundations for ML, ML Techniques overview, Validation Techniques (Cross-Validations), Feature Reduction/Dimensionality reduction, Principal components analysis (Eigen values, Eigen vectors, Orthogonality) **Unit 2:** Different clustering methods (Distance, Density, Hierarchical), distance measures, Iterative distance-based clustering, Dealing with continuous, categorical values in K-Mean, Constructing a hierarchical cluster, K-Medoids, k-Mode and density-based clustering, Measures of quality of clustering **Unit 3:** Naïve Bayes Classifier, Model Assumptions, probability estimation, required data processing, M-estimates, Feature selection **Unit 4:** Support Vector Machine, Linear learning machines and Kernel space, Making Kernels, working in feature space, SVM for classification and regression problems **Unit 5:** Recommender Systems, Problem Formulation, content-based recommendations, collaborative Filtering, vectorization **Unit 6:** Fundamentals of Artificial Intelligence, Introduction of A.I, A.I. Representation, Non-AI vs AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, types of production systems, Intelligent Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation **Unit 7:** Uninformed search strategies, Formulation of real world problems, Breadth First Search, Depth First Search, Depth Limited Search, Application of AI in the files of business management, Workflow and lifecycle of AI project in an organisation **Unit 8:** Introduction to Encoders, Auto-Encoders, Intelligent Agents and Uninformed search, Heuristic Search, Constraint Satisfaction Problems
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	**Core Reading List** 1. Basics of Artificial Intelligence & Machine Learning, Dr. Dheeraj Mehrotra, Notion Press, 2019 **Supplementary Reading List** 1. Artificial Intelligence: Concepts and Applications, Lavika Goel, Wiley, 2021 2. Data Science and Machine Learning using Python, Reema Thareja, McGraw Hill, 2021 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general fundamental, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**6. Machine Learning Methods using Python**

Module/Unit Description	The purpose of this course is to serve as an introduction to machine learning with Python. Learners will explore several clustering, classification, and regression algorithms and see how they can help us perform a variety of machine learning tasks. Then learners will apply what they have learned to generate predictions and perform segmentation on real-world data sets. In particular, learners will structure machine learning models as though they were producing a data product, an actionable model that can be used in larger programs. After this course, learners should understand the basics of machine learning and how to implement machine learning algorithms on your data sets using Python. Specifically, they should understand basic regression, classification, and clustering algorithms and how to fit a model and use it to predict future outcomes.
Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Understand Python libraries for machine learning and divide dataset into training and test datasets 2. Implement linear and polynomial regression, understand Ridge and lasso Regression, acquire programming skills in core Python 3. Identify appropriate techniques to solve the formulated AI & ML problem. 4. Develop the ability to write database applications in Python.
	Knowledge:

	At the end of the module/unit the learner will have been exposed to the following: 1. Apply key Python packages for machine learning, including Numpy, Scipy, and SciKit-Learn. 2. Learn techniques like scaling transformations and one-hot encoding for preparing raw data by using the procedures for standardising and normalising data features. 3. Comprehend the transition from statistical models to machine learning models. 4. Perform quantify model performance tests using various sets like training, validation, and test sets, and employ cross-validation techniques for robust model evaluation. 5. Understand the concept of clustering as an unsupervised learning technique, and its usage how clustering can be used to uncover patterns and structures within data.
	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Employ different metrics used to evaluate model performance and select appropriate ones. 2. Enhance model efficiency by implementing methods for feature selection.
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Employ different metrics used to evaluate model performance and select appropriate ones. 2. Enhance model efficiency by implementing methods for feature selection.

<table>
<tr><td></td><td colspan="2">Module-Specific Digital Skills and Competences
At the end of the module/unit, the learner will be able to

1. Dealing with different learning platforms
2. Use of the Office package or comparable office software
3. Creating online presentations
4. Independent online search on the Internet
5. Use of various video conferencing systems
6. Scan, print and upload online
7. Working with e-book readers
8. Using plagiarism software
9. Online peer-to-peer Collaboration
10. Communicating via WhatsApp, Skype Teams etc.
11. Independent organisation of student InterVision meetings based on various online platforms
12. Dealing with citation software
13. Use of sound transmission and camera on computer
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Total Number of ECTS of this Module/Unit	6 ECTS

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:**

	Unit 1: Introduction to Machine Learning, what is Machine Learning?, need for Machine Learning, why & When to Make Machines Learn?, challenges in Machines Learning, application of Machine Learning **Unit 2:** Components of Python ML Ecosystem, using Pre-packaged Python Distribution: Anaconda, Jupyter Notebook, NumPy, Pandas, Scikit-learn **Unit 3:** Regression Analysis (Part-I), regression Analysis, linear Regression, examples on Linear Regression, scikit-learn library to, implement simple linear regression **Unit 4:** Regression Analysis (Part-II), multiple Linear Regression, examples on Multiple Linear Regression, polynomial Regression, examples on Polynomial Regression **Unit 5:** Classification (Part-I), What is Classification, Classification Terminologies in Machine Learning, Types of Learner in, Classification, Logistic Regression, Example on Logistic Regression **Unit 6:** Classification (Part-II), What is KNN?How does the KNN algorithm work? How do you decide the number of neighbours in KNN?, Implementation of KNN classifier, What is a Decision Tree?, Implementation of Decision Tree, SVM and its implementation **Unit 7:** Clustering (Part-I), What is Clustering?, Applications of Clustering, Clustering Algorithms, K-Means Clustering, How does K-Means Clustering work?, K-Means Clustering algorithm example **Unit 8:** Clustering (Part-II), Hierarchical Clustering, Agglomerative Hierarchical clustering and how does it work, Working of Dendrogram in Hierarchical clustering, Implementation of Agglomerative Hierarchical Clustering **Unit 9:** Association Rule Learning, Association Rule Learning, Apriori algorithm, Working of Apriori algorithm, Implementation of Apriori algorithm **Unit 10**: Recommender Systems, Introduction to Recommender Systems, Content-based Filtering, How Content-based Filtering work, Collaborative Filtering, Implementation of Movie Recommender System

Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.
Reading List	**Core Reading List** 1. Machine Learning in Data Science Using Python, Dr. R. Nageswara Rao, Dreamtech Press, 2022 **Supplementary Reading List** 1. Machine Learning using Python, Manaranjan Pradhan, Wiley, 2019 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**7. Convolutional and Recurrent Neural Networks**

Module/Unit Description	This course is designed to provide an in-depth understanding of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), two fundamental architectures in the field of deep learning. Participants will gain hands-on experience in designing, implementing, and optimising these neural network types for various applications, including image recognition, natural language processing, and sequential data analysis.
Learning Outcomes	Competences:
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Explain the fundamental concepts behind Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). 2. Understand the architectural differences between CNNs and RNNs. 3. Demonstrate proficiency in designing and implementing CNNs for image classification tasks. 4. Understand the concept of convolutional layers, pooling layers, and fully connected layers.
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Implement transfer learning using pre-trained CNN architectures. 2. Implement basic RNN models and understand their limitations in handling sequential data. 3. Explore Long Short-Term Memory (LSTM) networks and Gated Recurrent Units (GRUs) as advanced RNN architectures. 4. Apply RNNs for tasks such as natural language processing and time series prediction.
	Skills:

	At the end of the module/unit the learner will have acquired the following skills: 1. Apply CNNs for tasks beyond image classification, such as object detection and image segmentation. 2. Apply RNNs for sequence-to-sequence tasks like language translation and speech recognition. 3. Compare and contrast different CNN and RNN architectures, understanding their strengths and weaknesses.
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Evaluate the impact of hyperparameters on the performance of CNNs and RNNs. 2. Develop practical programming skills for implementing CNNs and RNNs using popular deep learning frameworks like TensorFlow or PyTorch. 3. Solve real-world problems through hands-on coding assignments and projects.
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to: 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel

Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	We intend to offer programs in online model, hence our online didactic model is as follows: Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. Support: In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. Modular delivery: Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:**

	Unit 1: Overview of Neural Networks and Deep Learning, Applications of Neural Networks in Computer Vision and Natural Language Processing, Comparison with Traditional Machine Learning Models, Historical Perspective on CNNs and RNNs **Unit 2:** Understanding Image Data and Preprocessing, Introduction to Convolutional Layers, Pooling Layers and Stride, Architecture: LeNet, Hands-on: Image classification with LeNet **Unit 3:** Architectures: AlexNet, VGGNet, Transfer Learning and Fine-tuning, Residual Networks (ResNets), Hands-on: Transfer learning for image classification **Unit 4:** Object Detection Techniques (Region-based methods, Single-shot detectors), Image Segmentation with CNNs, Hands-on: Object detection and segmentation projects **Unit 5**: Introduction to Sequential Data and Time Series, Basics of Recurrent Layers, Challenges: Vanishing and Exploding Gradients, Hands-on: Time series prediction with basic RNNs **Unit 6:** Introduction to LSTMs, Advantages over Basic RNNs, Applications in Natural Language Processing, Hands-on: Sentiment analysis using LSTMs **Unit 7:** Gated Recurrent Units (GRUs), Sequence-to-Sequence Models, Encoder-Decoder Architectures, Attention Mechanisms in RNNs, Hands-on: Language translation project **Unit 8:** Hybrid Architectures (CNN-RNN), Capsule Networks, Recent Research Developments, Hands-on: Exploring cutting-edge architectures **Unit 9:** Techniques for Interpreting CNN and RNN Models, Ethical Considerations in AI and Deep Learning, Bias, Fairness, and Transparency in CNNs and RNNs, Project Discussions and Presentations.

Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.
Reading List	**Core Reading List** 1. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, 2016 2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron, 2019 **Supplementary Reading List** 1. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal, 2018 2. "Convolutional Neural Networks in Python: Introduction to Convolutional Neural Networks" by Anthony Williams, 2017 3. "Recurrent Neural Networks with Python Quick Start Guide" by Danijar Hafner, 2018 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general fundamental, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**8. Computer Vision and Image Recognition**
Module/Unit Description	The objectives are to develop understanding of the basic principles and techniques of image processing and image understanding, and to develop skills in the design and implementation of computer vision software. To introduce students the fundamentals of image formation; To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications
Learning Outcomes	Competences:
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Understand the fundamentals of image recognition. 2. Identify basic concepts, terminology, theories, models and methods in the field of computer vision 3. Suggest a design of a computer vision system for a specific problem
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Describe known principles of human visual system 2. Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition
	Skills:

	At the end of the module/unit the learner will have acquired the following skills: 1. Design and develop practical and innovative image processing and computer vision applications or systems 2. Identify, formulate and solve problems in image processing and computer vision	
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Analyse and develop a variety of algorithms for tasks in image processing and computer vision. 2. Critically review and assess scientific literature in the field and apply theoretical knowledge to identify the novelty and practicality of proposed methods	
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel	
Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours

	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	We intend to offer programs in online model, hence our online didactic model is as follows: Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. Support: In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. Modular delivery: Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Introduction, Background, requirements and issues, human vision **Unit 2:** Image formation: geometry and photometry, Geometry, photometry (brightness and colour), quantization, camera calibration

	Unit 3: Image segmentation and Feature Extraction Various methods of image segmentation, edge detection, object proposals, SIFT features **Unit 4:** Multi-view Geometry, Shape from stereo and motion, feature matching, surface fitting, Active ranging **Unit 5:** Object Recognition: Traditional Methods, HoG/SIFT features, Bayes classifiers, SVM classifiers **Unit 6:** Introduction to Neural Networks, Artificial neural networks, loss functions, backpropagation and SGD, Batch Normalisation **Unit 7:** Object Recognition: Deep Learning Methods, Image classification, object detection and semantic segmentation, adversarial attacks, Various neural network architectures, visualisation techniques. **Unit 8:** Motion analysis and Activity Recognition, Motion detection and tracking, Inference of human activity from image sequences **Unit 9** Examples: Face recognition, Image grounding, Visual question answering.
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	Core Reading List 1. "Computer Vision: Algorithms and Applications" by Richard Szeliski, Springer Nature, 2023 Supplementary Reading List 1. "Computer Vision: A Modern Approach" by David A. Forsyth and Jean Ponce, Prentice Hall India Learning Private Limited, 2020 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general fundamental, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**9. Natural Language Processing**
Module/Unit Description	The area of natural language processing (NLP) is expanding quickly and has broad applications in the humanities, social sciences, and hard sciences. Effective linguistic and textual data management, use, and analysis is a highly in-demand skill for academic research, in government, and in the corporate sector. The goal of this course is to provide a theoretical and methodological introduction to the most popular and successful current approaches, tactics, and toolkits for natural language processing, with a particular emphasis on those created by the Python programming language. Students will gain extensive experience using Python to conduct textual and linguistic analyses, and by the end of the course, they will have developed their own individual projects, gaining a practical understanding of natural language processing workflows along with specific tools and methods for evaluating the results achieved through NLP-based experiments. In addition to comparing new digital methodologies to traditional approaches to philological analysis, students will gain extensive experience using Python to conduct textual and linguistic analyses.

Learning Outcomes	Competences:
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Define and explain the key concepts and fundamental techniques in NLP. 2. Understand the challenges and complexities involved in processing natural language. 3. Acquire skills in cleaning and preprocessing text data.
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Understand the principles of text classification and its applications. 2. Implement supervised learning algorithms for text classification tasks. 3. Explore the basics of speech recognition and its connection to NLP. 4. Understand the challenges and techniques in converting spoken language into written text.
	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Apply NLP concepts to real-world projects. 2. Develop the ability to use NLP tools and frameworks for solving practical problems.

<table>
<tr><td rowspan="2"></td><td colspan="2">Module-Specific Learner Skills
At the end of the module/unit the learner will be able to

1. Explore methods for generating human-like text.
2. Implement text generation models using techniques like recurrent neural networks (RNNs) and transformers.
3. Explore advanced topics such as word embeddings, attention mechanisms, and transformer models.
4. Stay informed about recent advancements in the field.</td></tr>
<tr><td colspan="2">Module-Specific Digital Skills and Competences
At the end of the module/unit, the learner will be able to

1. Dealing with different learning platforms
2. Use of the Office package or comparable office software
3. Creating online presentations
4. Independent online search on the Internet
5. Use of various video conferencing systems
6. Scan, print and upload online
7. Working with e-book readers
8. Using plagiarism software
9. Online peer-to-peer Collaboration
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	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	We intend to offer programs in online model, hence our online didactic model is as follows: Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. 7. All interactions take place via e-campus to maintain an adequate record of information. Support: In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. **Course Content**: **Unit 1:** Introduction, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field. **Unit 2:** The problem of ambiguity. The role of machine learning. Brief history of the field. **Unit 3:** N-gram Language Models, The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. **Unit 4:** Part Of Speech Tagging and Sequence Labelling, Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training). **Unit 5:** Basic Neural Networks, Any basic introduction to perceptron and backpropagation in Artificial Intelligence.

	Unit 6: LSTM Recurrent Neural Networks, "Understanding LSTM Networks" blog post, optionally the original paper Long Short Term Memory. **Unit 7:** Syntactic parsing, Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing **Unit 8:** Semantic Analysis, Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing. **Unit 9:** Information Extraction (IE), Named entity recognition and relation extraction. IE using sequence labelling. **Unit 10:** Machine Translation (MT), Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. **Unit 11:** Project: Speech Recognition, Text Classification, Speech-to-text conversion, text-to-speech conversion, text translation Modular delivery: Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth.
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	Core Reading List 1. Sohom Ghosh, Dwight Gunning, " Natural Language Processing Fundamentals" , Packt Publishing, 2019. 2. Jurafsky and Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" 2/e, 2013. Supplementary Reading List 1. Natural Language Processing with Python, Edward Loper, Ewan Klein, and Steven Bird, 2009 2. NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010 3. James Allen "Natural Language Understanding", Pearson Publication 8th Edition, 2012 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**10. Big Data and NoSQL**
Module/Unit Description	The broad rise of large information stockpiling needs has driven the birth of databases generally alluded to as NoSQL information bases. This course will investigate the sources of NoSQL information bases and the qualities that recognize them from customary data set administration frameworks. Central ideas of NoSQL information bases will be introduced.

Learning Outcomes	Competences:
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Demonstrate an understanding of the detailed architecture of Big Data, define objects, load data, query data and performance tune Column-oriented NoSQL databases 2. Understand the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases 3. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Key-Value Pair NoSQL databases 4. Perform hands-on NoSql database lab assignments that will allow students to use the four NoSQL 5. Database types via products such as Cassandra, Hadoop Hbase, Mongo D acquire programming skills in core Python
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Work with big data tools and its analysis techniques 2. Analyse data by utilising clustering and classification algorithms 3. Learn and apply different mining algorithms and recommendation systems for large volumes of data 4. Perform analytics on data streams
	Skills:

At the end of the module/unit the learner will have acquired the following skills:

1. Understand the principles behind the NoSQL databases
2. Know architectures and common features of the main types of NoSQL databases (key-value
3. Stores, document databases, column-family stores, graph databases)
4. Know in detail several selected NoSQL database systems including practical experience
5. Know about other topics related to Big Data and non-relational databases (data analytics, DB in
6. Web browser, influence of NoSQL to relational databases, etc.)

Module-Specific Learner Skills

At the end of the module/unit the learner will be able to

1. Understand Big Data Concepts, characteristics, Data Management and Warehouse
2. Understand significance of Big Data and industry use case references
3. Comprehend grid computing and deployment architecture
4. Compare and contrast NoSQL with Hadoop skill of applying principles of tidy data

Module-Specific Digital Skills and Competences

At the end of the module/unit, the learner will be able to

1. Dealing with different learning platforms
2. Use of the Office package or comparable office software
3. Creating online presentations
4. Independent online search on the Internet
5. Use of various video conferencing systems
6. Scan, print and upload online
7. Working with e-book readers
8. Using plagiarism software
9. Online peer-to-peer Collaboration
10. Communicating via WhatsApp, Skype Teams etc.
11. Independent organisation of student InterVision meetings based on various online platforms
12. Dealing with citation software
13. Use of sound transmission and camera on computer
14. MS Excel

Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	We intend to offer programs in online model, hence our online didactic model is as follows: Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. Modular delivery: Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Big Data Introduction: data introduction - Big data: definition and taxonomy - Big data value for the enterprise - Setting up the demo environment - First steps with the Hadoop “ecosystem”

	Unit 2: The Hadoop Ecosystem, Introduction to Hadoop, Hadoop components: MapReduce/Pig/Hive/HBase, Loading data into Hadoop, Handling files in Hadoop Getting data from Hadoop **Unit 3:** Querying big data with Hive, Introduction to the SQL Language - From SQL to HiveQL, Using Hive to query Hadoop files **Unit 4**: Big data & Machine learning, Quick intro to Machine learning, Big Data & Machine Learning, Machine learning tools: Spark & SparkML, H2O, Azure ML **Unit 5:** NoSQL Database, Define what is NoSQL database, its need and differences from traditional databases, Knowledge on various tools available: as MongoDB, Cassandra, HBase etc, Explore the principles of NoSQL using examples in MongoDB **Unit 6:** Data Model: Develop an understanding of the available data models, value stores, document databases, column-family stores, graph databases, Understand the basic storage architecture in a distributed environment, column-oriented databases, nested maps of key/value pairs, HBase distributed storage architecture **Unit 7**: Using NoSQL, Value databases using MongoDB, Cassandra etc., NoSQL database development tools, programming languages **Unit 8:** Data access control, Hadoop distributed storage architecture, discussion about Map Reduce processing framework **Unit 9:** HDFS, overview of HDFS, HDFS Deployment, Core HDFS services, Check pointing, Multi-node cluster with docker **Unit 10**: MongoDB, The document data model, Documents and collections, MongoDB Use Cases, Embedded data models, Normalised data, Indexing, Writing to shards.
Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.

Reading List	Core Reading List 1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analysing, Visualizing and Presenting Data", Wiley publishers, 2018 Supplementary Reading List 1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014 2. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Morgan Claypool publishers, 2010 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**11. Data Warehousing and management**
Module/Unit Description	In this course, learners will learn exciting concepts and skills for designing data warehouses and creating data integration workflows. These are fundamental skills for data warehouse developers and administrators. Learners will have hands-on experience for data warehouse design and use open source products for manipulating pivot tables and creating data integration workflows. In the data integration assignment, learners can use either Oracle, MySQL, or PostgreSQL databases. Learner will also gain conceptual background about maturity models, architectures, multidimensional models, and management practices, providing an organisational perspective about data warehouse development. If a learner wants to become a data warehouse designer or administrator, this course will give accurate knowledge and skills to do that. By the end of the course, learner will have the design experience, software background, and organisational context that prepares you to succeed with data warehouse development projects. In this course, learners will create data warehouse designs and data integration workflows that satisfy the business intelligence needs of organisations.

Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Provide a brief introduction to Data Warehouse and Data Management 2. Understanding of the different architectures in data warehouse 3. Evaluate an organisation for data warehouse maturity and business architecture alignment 4. Create a data warehouse design and reflect on alternative design methodologies and design goals
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Create data integration workflows using prominent open source software 2. Create, populate with data, and extract useful information from a data warehouse 3. Address the challenges of using data warehousing in strategic decision making, calculate the costs, and name the benefits and limitations of such an approach.
	Skills:

	At the end of the module/unit the learner will have acquired the following skills: 1. Use the data warehouse solution to perform simple data mining tasks 2. Re-engineer the operational database(s) of a given enterprise and provide a data warehouse 3. Design focused on addressing the most important informational and analytical needs of the enterprise 4. Apply specific design techniques (data partitioning; denormalization; multidimensional, star and snow-flake design models to address the data structuring challenges of the data warehouse development process 5. Address the challenges of data acquisition and the ETL (Extract/Transform/Load) process
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Perform operations on pivot tables to satisfy typical business analysis requests using prominent open source software 2. Reflect on the role of change data, refresh constraints, refresh frequency trade-offs, and data quality goals in data integration process design 3. Assess the effectiveness and usability of data warehousing solutions

<table>
<tr><td></td><td colspan="2">Module-Specific Digital Skills and Competences
At the end of the module/unit, the learner will be able to

1. Dealing with different learning platforms
2. Use of the Office package or comparable office software
3. Creating online presentations
4. Independent online search on the Internet
5. Use of various video conferencing systems
6. Scan, print and upload online
7. Working with e-book readers
8. Using plagiarism software
9. Online peer-to-peer Collaboration
10. Communicating via WhatsApp, Skype Teams etc.
11. Independent organisation of student InterVision meetings based on various online platforms
12. Dealing with citation software
13. Use of sound transmission and camera on computer
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<tr><td rowspan="2">Hours of Total Learning for this Module/Unit</td><td>Total Contact Hours</td><td>Supervised Placement and Practice Hours</td></tr>
<tr><td>Self-Study Hours</td><td>Assessment Hours</td></tr>
<tr><td>Total Learning Hours of this Module</td><td colspan="2">_____150_____ Hours</td></tr>
<tr><td rowspan="2">Mode of Delivery</td><td>Fully Face-to-Face Learning ☐</td><td>Blended Learning ☐</td></tr>
<tr><td>Fully Online Learning ☒</td><td>Work Based Learning ☐</td></tr>
</table>

Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support .	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Fundamentals of Data Warehouse, Introduction of data warehouse Meaning and characteristics of Data Warehousing, Online Transaction Processing (OLTP), Data Warehousing Models, Data warehouse architecture, Principles of Data Warehousing Data Mining

	Unit 2: Building a Data Warehouse Project, Structure of the Data warehouse, Data warehousing and Operational Systems, Organising for building data warehousing, Important considerations – Tighter integration, Empowerment, Willingness Business Considerations, Return on Investment Design Considerations, Technical Consideration, Implementation Consideration, Benefits of Data warehousing **Unit 3:** Managing and implementing a Data Warehouse Project, Planning and Requirements: Key Issues in Planning a Data Warehouse, Planning and Project Management in Data Warehouse Construction, Data Warehouse Project, Analysing Probability and Risk, Managing Risk: Internal and External, Critical Path Analysis **Unit 4:** Data Warehouse Architecture, Components of Data Warehouse Architecture, Technical Architectures, Tool Selection, Federated Data Warehouse Architecture **Unit 5:** Dimensional Modelling, E-R Modeling, Dimensional Modelling E-R Modeling VS Dimensional Modelling, Data Warehouse Schemas Snowflake Schema, Fact Constellation Schema **Unit 6:** Extract, Transform and Load, ETL Overview, ETL Requirements and Steps, Data Transformation, Data Loading, ETL Tools **Unit 7:** Data Warehouse & OLAP, What is OLAP?, Multidimensional Data OLAP Architectures, Data Warehouse and OLAP, Hypercube & Multicubes **Unit 8**: Data Mining: What is Data mining (DM)?, Definition and description, Relationship and Patterns, KDD vs Data mining, DBMS vs Data mining, Elements and uses of Data Mining, Measuring Data Mining Effectiveness, Accuracy, Speed & Cost Data Information and Knowledge, Data Mining vs. Machine Learning, Data Mining Models, Issues and challenges in DM, DM Applications Areas **Unit 9:** Techniques of Data Mining, Various Techniques of Data Mining, Nearest Neighbour and Clustering Techniques, Decision Trees, Discovery of Association Rules, Neural Networks, Genetic Algorithm **Unit 10:** Metadata Management in Data Warehouse, Metadata Management in Data Warehouse, Introduction to Metadata, Categorizing Metadata, Metadata management in practice, Tools for Metadata management.

Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 week's before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.
Reading List	**Core Reading List** 1. Data Warehousing Study Guide, Dr.Noah Ras, Student Study Guides, 2018 **Supplementary Reading List** 1. Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2016 2. The Data Warehouse Toolkit,Ralph Kimball, 2013 3. Building a Data Warehouse, Vincent Rainardi, 2008 The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**12. Research Methods**

Module/Unit Description	A research methodology course equips students with the foundational skills and knowledge needed to conduct rigorous and effective research across various disciplines. Through this course, students learn the principles and techniques essential for designing, executing, and interpreting research studies. They delve into topics such as formulating research questions, selecting appropriate data collection methods, understanding sampling techniques, and mastering data analysis methods, both qualitative and quantitative. Moreover, the course covers ethical considerations, emphasising responsible and transparent research practices. Students gain proficiency in constructing research proposals, reviewing existing literature, and presenting findings with clarity and precision. This course is highly relevant to understand the systematic scientific research writing process. This process helps in putting in perspective all conceptual learning and provides a framework for continuous growth in one's own work environment.
Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Formulate a relevant research design that enables to answer the identified research questions, considering the limitations of the study. 2. Implement evidence-based management perspectives to design research problems that can enhance the overall value to the stakeholders. 3. Comprehend ethical considerations in research, including subjects' rights and integrity.
	Knowledge:

	At the end of the module/unit the learner will have been exposed to the following: 1. Recall three pillars of evidence-based management- existing knowledge, conceptual framework and own prior experience to identify the research gap. 2. Forecast the application of possible recommendations that can be drawn from the research under study and its impact on the stakeholders, keeping the stakeholders informed and considering all ethical concerns concerning stakeholders. 3. Conduct systematic literature review to identify the research gap and build upon the variables under study. 4. Formulate a research design that enables to answer the identified research questions, select data collection and analysis method that corresponds to research questions, for instance selecting surveys for quantitative and causal research, whereas observations and small interviews for qualitative research.
	Skills:
	At the end of the module/unit the learner will have acquired the following skills: 1. Differentiate between qualitative and quantitative research methods. 2. Formulate clear and focused research questions or hypotheses. 3. Learn to identify variables, develop operational definitions, and choose appropriate measurement scales. 4. Understand surveys, experiments, and observational methods used in quantitative research. 5. Describe and summarise collected data using appropriate statistical measures. 6. Learn to structure and write a research report, including results, discussion, and conclusions.

	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Develop skills to write a comprehensive research proposal, including introduction, methodology, and expected outcomes. 2. Develop effective presentation skills to communicate research findings clearly. 3. Learn about proper citation practices and how to avoid plagiarism.	
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel	
Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____150_____ Hours	

Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	6 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 3. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Introduction to Research Methods:Understanding the nature and purpose of research, Differentiating between qualitative and quantitative research

	Unit 2: Research Design:Formulating research questions and hypotheses, Selecting appropriate research designs (experimental, correlational, descriptive, etc.), Considering ethical considerations in research design **Unit 3:** Sampling Techniques:Understanding different sampling methods (random sampling, stratified sampling, convenience sampling, etc.), Assessing sample size and representativeness **Unit 4:** Data Collection Methods:Surveys and questionnaires, Interviews (structured, semi-structured, unstructured), Observational methods (participant observation, naturalistic observation), Experimental methods, Case studies, Archival research **Unit 5:** Measurement and Instrumentation: Reliability and validity of measurement instruments, Types of measurement scales (nominal, ordinal, interval, ratio), Constructing and validating measurement instruments **Unit 6:** Data Analysis Techniques: Descriptive statistics (mean, median, mode, standard deviation, etc.), Inferential statistics (t-tests, ANOVA, correlation, regression, etc.), Qualitative data analysis techniques (content analysis, thematic analysis, grounded theory, etc.) using statistical software (SPSS, R, SAS, etc.) **Unit 7:** Interpreting and Presenting Results: Interpreting statistical findings, Drawing conclusions based on research results, Presenting findings through written reports, presentations, and visualisations, Critical Thinking and Research **Unit 8:** Ethics: Evaluating research studies critically, Understanding ethical principles in research (informed consent, confidentiality, minimising harm, etc.), Recognizing and avoiding research misconduct (plagiarism, fabrication, falsification) **Unit 9:** Special Topics in Research Methods: Meta-analysis, Longitudinal studies, Mixed methods research, Cross-cultural research methods, Online research methods and digital data collection **Unit 10:** Practical Applications and Projects: Hands-on experience with designing research studies, Conducting data collection and analysis Presenting research findings.

Assessment	This course will be assessed by continuous and end of the course assessment. Continuous assessment is conducted within various units studied by the learner, and counts towards the final grades, the weightage of continuous assessment is 40%. The nature of continuous assessment is normally multiple choice questions. End of the module assessment is the final assessment, consisting of 60% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program. The student must pass in individual components and overall.
Reading List	**Core Reading List** 1. Research Methods for Business Students Paperback – 27 Mar. 2023 English edition by Mark Saunders (Autor), Philip Lewis (Autor), Adrian Thornhill (Autor) **Supplementary Reading List** Research papers, journals are recommended The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general principle, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Title of the Module/Unit	**13. Capstone Consulting Project**

Module/Unit Description	The Capstone Consulting Project in Data Science and Artificial Intelligence is the culminating experience for students pursuing a specialisation in these fields. This course provides students with the opportunity to apply their knowledge and skills to real-world problems through a hands-on consulting project. Working in teams, students will collaborate with industry partners or organisations to address challenging data science and AI problems.
Learning Outcomes	**Competences:**
	At the end of the module/unit the learner will have acquired the responsibility and autonomy to: 1. Apply advanced data science and AI techniques to solve complex, real-world problems. 2. Apply project management principles to ensure timely and successful project completion 3. Effectively communicate project progress, findings, and challenges to both technical and non-technical stakeholders.
	Knowledge:
	At the end of the module/unit the learner will have been exposed to the following: 1. Understand and address ethical considerations related to data science and AI projects. 2. Produce comprehensive technical documentation that details the project's methodology, data sources, models, and results. 3. Develop and deliver clear and compelling presentations summarising the consulting project
	Skills:

	At the end of the module/unit the learner will have acquired the following skills: 1. Demonstrate critical thinking skills in identifying, analysing, and solving complex problems in the context of data science and AI. 2. Apply data science techniques and methodologies to solve real-world problems 3. Evaluate the impact of data science solutions on stakeholders and society, reflecting on the strengths, limitations, and implications of their work.
	Module-Specific Learner Skills At the end of the module/unit the learner will be able to 1. Independent learning, sense making, consultation, evidence selection and data collection, application and use of theory in relation to practice, formulation of implementation plans, decision-making, communication, and the capacity to reflect upon their own learning and professional development. 2. Learn about proper citation practices and how to avoid plagiarism.
	Module-Specific Digital Skills and Competences At the end of the module/unit, the learner will be able to 1. Dealing with different learning platforms 2. Use of the Office package or comparable office software 3. Creating online presentations 4. Independent online search on the Internet 5. Use of various video conferencing systems 6. Scan, print and upload online 7. Working with e-book readers 8. Using plagiarism software 9. Online peer-to-peer Collaboration 10. Communicating via WhatsApp, Skype Teams etc. 11. Independent organisation of student InterVision meetings based on various online platforms 12. Dealing with citation software 13. Use of sound transmission and camera on computer 14. MS Excel

Hours of Total Learning for this Module/Unit	Total Contact Hours	Supervised Placement and Practice Hours
	Self-Study Hours	Assessment Hours
Total Learning Hours of this Module	_____450_____ Hours	
Mode of Delivery	Fully Face-to-Face Learning ☐	Blended Learning ☐
	Fully Online Learning ☒	Work Based Learning ☐
Blended Learning	Contact Hours Delivered Fully Online	Contact Hours Delivered Fully Face-to-Face
Total Number of ECTS of this Module/Unit	18 ECTS	

Teaching & Support	**We intend to offer programs in online model, hence our online didactic model is as follows:** Each module is organised on our e-campus and is divided into subunits, around 8-10 sub units depending upon the module credits. Each sub-unit comprises of the following resources: 1. Faculty Lecture- can be asynchronous with academic support OR synchronous, recording of which to be provided. 2. Notes of the faculty lecture 3. Supporting reading material such as research papers, articles, journals, video case studies, Harvard or other case studies, simulations, etc. 4. Unit-wise assessment which is multiple choice questions. 5. Optional – Formative challenge based discussion forum for reflection and peer-to-peer interaction. 6. After the student completes all units, the student is required to attempt a module project/ case study/ report writing etc kind of submission. **Support:** In online delivery, support plays an imperative role. Our model provides various levels of interaction to the students as follows: 1. Student Success Manager: is the first point of contact for every student for any query. 2. If it is a general query, for instance related to e-campus, technology, etc. it is resolved immediately. 3. If it is a faculty/ module content related query, this is forwarded to the assistant faculty. 4. If it is a program related query such as regulations, policies, progression etc, this is forwarded to the Program Director. 5. In all cases, the turn around time to resolve the query is within 3 working days. 6. All interactions take place via e-campus to maintain an adequate record of information. **Modular delivery:** Understanding the relevance of disseminating content in a systematic manner, we follow a modular system of academic delivery via our e-campus. 1. Modular system of academic delivery means that the learners are provided access to 1 module at one time. He/She completes all units, and final evaluation and once passed the module, he/she progresses over the next module. 2. The process helps in organising study in a better way, and also enables learners to research on a single module in-depth. **Course Content:** **Unit 1:** Project Initiation, Introduction to the consulting project, Meeting with industry partners or clients, Defining project scope and objectives **Unit 2:** Literature Review and Methodology Conduct a literature review related to the project, Select and justify the appropriate data science and AI methodologies, Develop a project plan and timeline

	Unit 3: Data Collection and Preprocessing, Acquire and clean relevant datasets, Perform exploratory data analysis (EDA), Implement data preprocessing techniques **Unit 4:** Model Development and Evaluation, Build and train data science and AI models, Evaluate model performance and make adjustments as needed, Document the model development process **Unit 5:** Project Implementation, Implement the chosen solution in a real-world context, Monitor and troubleshoot the implementation **Unit 6:** Final Presentation and Documentation, Prepare and deliver a final presentation to industry partners or clients, Submit comprehensive technical documentation.
Assessment	This course will be assessed by the end of the course assessment. End of the module assessment is the final assessment, consisting of 100% weightage. The nature of final assessment is the report submission. All assessments are provided via e-campus, and are to be submitted via e-campus. No email submissions can be accepted. All end of the module assessments must be provided to the learners at least 3 weeks before the submission due date. However, your research methods course will introduce the Capstone requirements so that you can start reading towards selection of your topic. The faculty will have access to the plagiarism testing software, and the learner can be asked for viva to validate the submitted assignment ownership, in case required. Please refer to the Assessment Policy for the rubric for the overall program.

Reading List	**Core Reading List** 1. Research Methods for Business Students Paperback – 27 Mar. 2023 English edition by Mark Saunders (Autor), Philip Lewis (Autor), Adrian Thornhill (Autor) **Supplementary Reading List** 1. Morales, A., 2006. A sample qualitative dissertation proposal. *Lincoln, NE: The*. 2. Stedman, K.D., 2011. Annoying ways people use sources. *Writing spaces: Readings on writing*, p.242. 3. McNiff, J., 2017. Action research: All you need to know. Sage. 4. Research papers, journals are recommended The above is not an exhaustive list. Further unit-wise readings are shared by faculty via VLE and are updated at regular intervals. The readings are constantly updated as well. As a general fundamental, we don't make books mandatory at Level 7 and above, rather we recommend books and expect wider research. To start with, faculty do share some reading resources, however it is expected that learners research beyond what is shared by the faculty and aim to implement the learning in their current industry.

Need Any Help?

Talk to our Admissions Counsellor: +49 176 584 00038 | +91 99005 01940 | (+356) 9933 4148
Mail Us At: connect@www.euglobal.edu.eu
Visit Us: www.euglobal.edu.eu

Our Address:
Malta - Punchbowl Centre Elija Zammit Street San Ġiljan, STJ 3154, Malta.