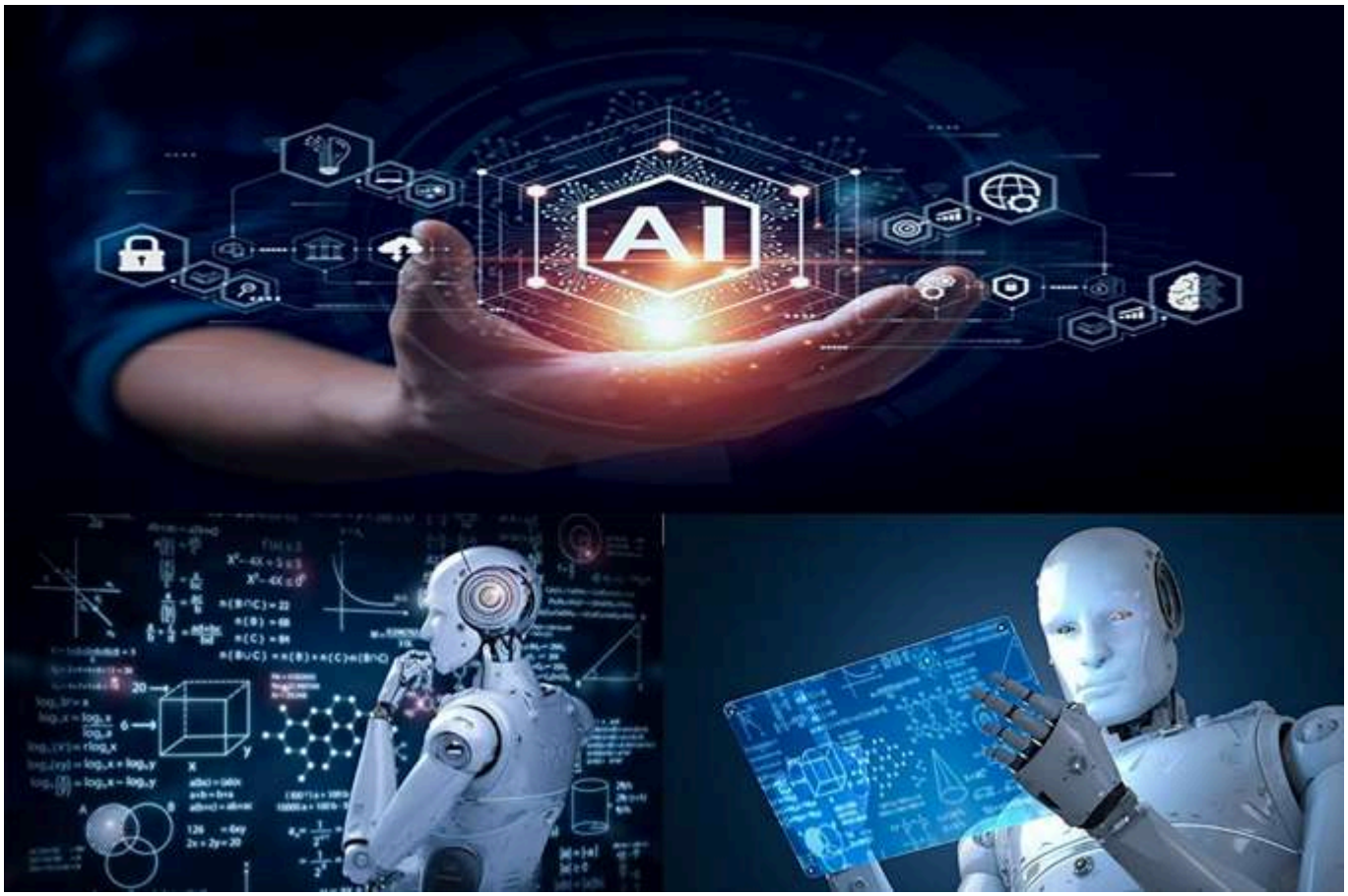
Qualification Pack



A.I (Artificial Intelligence) - Technocrat

Electives: Applications of AI in Mechanical Domain

QP Code: ICE/ITS/Q0201 Instantiated QP Code: ICE/ITS/Q0201-SI004

Version: 1.0

NSQF Level: 5

Integrated Council for Entrepreneurship and Skilling || 533-R
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Qualification Pack

ICE/ITS/Q0201-SI004: A.I (Artificial Intelligence) - Technocrat

Brief Job Description

AI Technocrats design and implement artificial intelligence solutions across diverse engineering disciplines. They optimize systems and processes using intelligent algorithms and automation, enhancing efficiency and innovation. Their work focuses on developing AI-driven tools that address industry challenges while promoting sustainability by reducing waste and energy consumption, ultimately fostering ecological balance and improving operational performance across various Engineering sectors.

Personal Attributes

They are analytical, adaptive collaborative with strong problem-solving skills and a commitment to continuous learning in AI technologies.

Applicable National Occupational Standards (NOS)

Compulsory NOS:

1. ICE/ITS/N0201: Fundamentals of Artificial Intelligence (AI)
2. ICE/ITS/N0202: Python Programming and data science for AI
3. ICE/ITS/N0203: Building Blocks of Artificial Intelligence (A.I)
4. DGT/VSQ/N0102: Employability Skills (60 Hours)

Electives*(mandatory to select at least one):*

Elective : Applications of AI in Mechanical Domain

This course examines the applications of artificial intelligence (AI) tools and algorithms within the field of Mechanical Engineering. It explores how AI can enhance design processes, optimize performance, and improve predictive maintenance, ultimately leading to increased efficiency and innovation in mechanical systems and technologies.

1. ICE/ITS/N0207: Applications of AI tools/algorithms in Mechanical Engineering

Qualification Pack (QP) Parameters

Sector	Information Technology Sector
Sub-Sector	Future skills

Qualification Pack

Occupation	Artificial Intelligence
Country	India
NSQF Level	5
Credits	20
Aligned to NCO/ISCO/ISIC Code	NCO-2015/3123.0302 & 3123.0400 & 3122.5600
Minimum Educational Qualification & Experience	Completed 2nd year of UG (UG Diploma) OR Pursuing 2nd year of UG (3 years / 4 years) OR Completed 2nd year diploma after 12th OR Completed 3 year diploma after 10th with 1.5 years of experience relevant stream experience OR Previous relevant Qualification of NSQF Level (4.5) with 1.5 years of experience relevant stream experience
Minimum Level of Education for Training in School	Not Applicable
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 Years
Last Reviewed On	17/12/2024
Next Review Date	17/12/2027
NSQC Approval Date	17/12/2024
Version	1.0
Reference code on NQR	QG-05-IT-03423-2024-V1-TICE
NQR Version	1

Qualification Pack

ICE/ITS/N0201: Fundamentals of Artificial Intelligence (AI)

Description

This unit covers the Fundamental of Artificial Intelligence (AI) exploring the foundational ideas, key techniques and widespread use of A.I across various fields.

Scope

The scope covers the following :

- This introductory unit explores core concepts like machine learning, neural networks, and natural language processing. And on how AI is applied in automation, decision-making, and problem-solving. Furthermore, this also addresses the ethical implications, current limitations, and the exciting future prospects of AI technology.

Elements and Performance Criteria

Introduction to AI

To be competent, the user/individual on the job must be able to:

PC1. Understand the basic concepts and definitions of Artificial Intelligence and its significance in various technical trades.

PC2. Demonstrate knowledge of AI applications in technical fields, such as predictive maintenance, automation, quality control, and resource optimization.

PC3. Explain the role of machine learning and data analytics in enhancing decision-making processes within technical trades.

PC4. Understand the importance of data collection and management for effective AI implementation including the use of IoT devices and sensors.

PC5. Evaluate the impact of AI on workflow efficiency, cost reduction, and productivity improvement in various technical trades.

The Ethical Landscape of AI and its Societal Impact

To be competent, the user/individual on the job must be able to:

PC6. Understand the core principles of AI ethics, including fairness, accountability, transparency, and the responsible use of AI technologies.

PC7. Describe the impact of AI on privacy and surveillance, discussing the ethical considerations surrounding data collection and user consent.

PC8. Explore the implications of AI on employment and workforce dynamics including the potential for job displacement and the need for workforce reskilling.

PC9. Understand the importance of regulatory frameworks and policies in governing AI technologies to ensure ethical practices and protect societal interests.

PC10. Analyze ethical considerations and challenges associated with the adoption of AI technologies, such as data privacy concerns, potential job displacement, and algorithmic bias

PC11. Discuss the potential societal benefits of AI, such as improved healthcare, enhanced public safety, and advancements in education while recognising the associated ethical challenges.

Aptitude & Mathematics Fundamentals

To be competent, the user/individual on the job must be able to:

PC12. Describe basic mathematical concepts, including algebra, calculus, and statistics, essential for understanding AI algorithms and models.

PC13. Understand the principles of linear algebra, including vectors, matrices, and operations, and their applications in machine learning and data manipulation.

PC14. Discuss probability theory to analyse uncertainty in AI models, including concepts such as conditional probability, Bayes' theorem, and distributions

PC15. Explain statistical methods for data analysis, including hypothesis testing, regression analysis and descriptive statistics.

PC16. Understand the significance of optimization techniques, including gradient descent and convex optimization in training machine learning models.

Data Handling

To be competent, the user/individual on the job must be able to:

PC17. Understand the importance of data quality and data cleaning processes including handling missing values, outliers and duplicates to ensure reliable AI model performance.

PC18. Explain data pre-processing techniques, such as normalization, standardization, and encoding categorical variables, to prepare data for analysis

PC19. Describe data exploration and visualization techniques using tools like Matplotlib and Seaborn to understand data distributions, correlations, and trends.

PC20. Understand the significance of data splitting methods (e.g., training, validation, and test sets) in building robust AI models and preventing overfitting.

PC21. Examine techniques for storing and retrieving data, including databases, data lakes, and data warehouses, for effective data management.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Core definition of Artificial Intelligence and its distinction from traditional computing, including concepts like machine learning, deep learning, and neural networks.

KU2. Historical development of AI, key milestones, and influential figures in the field.

KU3. Different types of AI, including narrow AI (specific tasks) and general AI (human-like capabilities), along with their implications.

KU4. Fundamental concepts of machine learning, including supervised, unsupervised, and reinforcement learning paradigms

KU5. Critical role of data in AI, including data collection, pre-processing, and the significance of high- quality datasets for model training.

KU6. Key algorithms used in AI and machine learning, such as decision trees, support vector machines, and neural networks

KU7. Various applications of AI across industries, including healthcare, finance, transportation, and entertainment, and their societal impact.

KU8. Awareness of emerging trends in AI, such as advancements in natural language processing, computer vision.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. Listen and communicate effectively and accurately.
GS2. Apply problem-solving approaches for different situations.
GS3. Work effectively in a team.
GS4. Employ proper time management.
GS5. Plan and organize work.
GS6. Maintain hygiene and sanitation.
GS7. Apply analytical skills for solving problems.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Introduction to AI	**10**	**10**	**-**	**2**
PC1. Understand the basic concepts and definitions of Artificial Intelligence and its significance in various technical trades.	-	-	-	-
PC2. Demonstrate knowledge of AI applications in technical fields, such as predictive maintenance, automation, quality control, and resource optimization.	-	-	-	-
PC3. Explain the role of machine learning and data analytics in enhancing decision-making processes within technical trades.	-	-	-	-
PC4. Understand the importance of data collection and management for effective AI implementation including the use of IoT devices and sensors.	-	-	-	-
PC5. Evaluate the impact of AI on workflow efficiency, cost reduction, and productivity improvement in various technical trades.	-	-	-	-
The Ethical Landscape of AI and its Societal Impact	**10**	**10**	**-**	**2**
PC6. Understand the core principles of AI ethics, including fairness, accountability, transparency, and the responsible use of AI technologies.	-	-	-	-
PC7. Describe the impact of AI on privacy and surveillance, discussing the ethical considerations surrounding data collection and user consent.	-	-	-	-
PC8. Explore the implications of AI on employment and workforce dynamics including the potential for job displacement and the need for workforce reskilling.	-	-	-	-
PC9. Understand the importance of regulatory frameworks and policies in governing AI technologies to ensure ethical practices and protect societal interests.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. Analyze ethical considerations and challenges associated with the adoption of AI technologies, such as data privacy concerns, potential job displacement, and algorithmic bias	-	-	-	-
PC11. Discuss the potential societal benefits of AI, such as improved healthcare, enhanced public safety, and advancements in education while recognising the associated ethical challenges.	-	-	-	-
Aptitude & Mathematics Fundamentals	**10**	**15**	**-**	**3**
PC12. Describe basic mathematical concepts, including algebra, calculus, and statistics, essential for understanding AI algorithms and models.	-	-	-	-
PC13. Understand the principles of linear algebra, including vectors, matrices, and operations, and their applications in machine learning and data manipulation.	-	-	-	-
PC14. Discuss probability theory to analyse uncertainty in AI models, including concepts such as conditional probability, Bayes' theorem, and distributions	-	-	-	-
PC15. Explain statistical methods for data analysis, including hypothesis testing, regression analysis and descriptive statistics.	-	-	-	-
PC16. Understand the significance of optimization techniques, including gradient descent and convex optimization in training machine learning models.	-	-	-	-
Data Handling	**10**	**15**	**-**	**3**
PC17. Understand the importance of data quality and data cleaning processes including handling missing values, outliers and duplicates to ensure reliable AI model performance.	-	-	-	-
PC18. Explain data pre-processing techniques, such as normalization, standardization, and encoding categorical variables, to prepare data for analysis	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC19. Describe data exploration and visualization techniques using tools like Matplotlib and Seaborn to understand data distributions, correlations, and trends.	-	-	-	-
PC20. Understand the significance of data splitting methods (e.g., training, validation, and test sets) in building robust AI models and preventing overfitting.	-	-	-	-
PC21. Examine techniques for storing and retrieving data, including databases, data lakes, and data warehouses, for effective data management.	-	-	-	-
NOS Total	**40**	**50**	**-**	**10**

National Occupational Standards (NOS) Parameters

NOS Code	ICE/ITS/N0201
NOS Name	Fundamentals of Artificial Intelligence (AI)
Sector	Information Technology Sector
Sub-Sector	
Occupation	Artificial Intelligence
NSQF Level	5
Credits	1.5
Version	1.0
Last Reviewed Date	17/12/2024
Next Review Date	17/12/2027
NSQC Clearance Date	17/12/2024

ICE/ITS/N0202: Python Programming and data science for AI

Description

This module emphasizes the use of Python for developing and applying AI algorithms. It provides a comprehensive overview of how to implement these technologies effectively. Participants will learn to harness Python's capabilities in the field of artificial intelligence.

Scope

The scope covers the following :

- It covers Python libraries such as NumPy, Pandas, TensorFlow, and PyTorch, which are essential for machine learning and deep learning data processing. This also includes practical programming techniques for building AI models, handling datasets, and creating AI-powered solutions.

Elements and Performance Criteria

Introduction to Python Programming

To be competent, the user/individual on the job must be able to:

PC1. Understand Python syntax, including variables, data types, loops, and conditionals for basic programming tasks.

PC2. Discuss fundamental Python data structures such as lists, dictionaries, tuples, and sets in data manipulation.

PC3. Discuss to utilize Python functions and modules to write reusable and efficient code.

PC4. Understand to use Python for file handling operations such as reading from and writing to files.

PC5. Describe to use of Python libraries like NumPy and Pandas for basic data manipulation and analysis tasks.

PC6. Discuss basic debugging and error-handling techniques to identify and resolve issues in Python programs

Data Structures and Algorithms in Python

To be competent, the user/individual on the job must be able to:

PC7. Understand the fundamentals data structures such as arrays, linked lists, stacks, queues, trees, and graphs in Python.

PC8. Describe to utilize Python's built-in data structures, such as lists, dictionaries, sets, and tuples, to solve problems effectively.

PC9. Discuss common algorithms for sorting (e.g., bubble sort, quicksort, mergesort) and searching (e.g., linear search, binary search) on various data structures.

PC10. Understand the concepts of complexity analysis, including time and space complexity, to evaluate the efficiency of algorithms.

PC11. Describe recursion and its applications in solving problems, including tree traversal and backtracking algorithms.

PC12. Understand to solve practical problems and to utilize data structures to optimize performance in Python applications.

Object-Oriented Programming (OOP) in Python

To be competent, the user/individual on the job must be able to:

PC13. Understand the core principles of Object-Oriented Programming (OOP), including encapsulation, inheritance, and polymorphism.

PC14. Define to use classes and objects in Python to model real-world entities and behaviors.

PC15. Discuss constructor and destructor methods to initialize and clean up object attributes in Python classes.

PC16. Understand to utilize class inheritance to create subclasses to extend or modify the functionality of parent classes.

PC17. Describe method overriding to customize the behavior of inherited methods in derived classes.

PC18. Discuss the concept of abstraction through abstract classes and interfaces to understand the design concept of flexible and modular code.

Libraries for AI and Data Science

To be competent, the user/individual on the job must be able to:

PC19. Understand to use NumPy for numerical computations including array manipulation, mathematical operations and linear algebra.

PC20. Describe Pandas for data manipulation and analysis to utilize dataFrames for data cleaning, transformation and aggregation tasks.

PC21. Understand data visualization techniques using Matplotlib and Seaborn to create informative plots and graphs Seaborn.

PC22. Discuss to utilize Scikit-learn for building and evaluating machine learning models, including data preprocessing, feature selection and model selection techniques.

PC23. Understand to use TensorFlow or PyTorch for developing and training deep learning models, including defining architectures and optimizing performance.

PC24. Discuss Natural Language Toolkit (NLTK) or spaCy for text processing tasks in Natural Language Processing (NLP), including tokenization, stemming and recognition.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Core syntax and fundamental concepts of Python, including variables, data types, control structures, functions, and error handling.

KU2. Python data structures such as lists, tuples, dictionaries, and sets, and their appropriate use cases in programming.

KU3. Key Python libraries used in data science and AI, including NumPy for numerical operations, Pandas for data manipulation, and Matplotlib/Seaborn for data visualization

KU4. Methods for cleaning and preprocessing data, including handling missing values, normalization, standardization, and encoding categorical variables.

KU5. Principles of object-oriented programming (OOP) in Python, including classes, objects, inheritance, encapsulation, and polymorphism.

KU6. Ability to create visualizations to interpret data and communicate findings effectively using libraries like Matplotlib and Seaborn.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. Listen and communicate effectively and accurately.
GS2. Apply problem-solving approaches for different situations
GS3. Work effectively in a team.
GS4. Employ proper time management.
GS5. Plan and organize work.
GS6. Maintain hygiene and sanitation.
GS7. Analytical skills.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Introduction to Python Programming	**10**	**10**	**-**	**2**
PC1. Understand Python syntax, including variables, data types, loops, and conditionals for basic programming tasks.	-	-	-	-
PC2. Discuss fundamental Python data structures such as lists, dictionaries, tuples, and sets in data manipulation.	-	-	-	-
PC3. Discuss to utilize Python functions and modules to write reusable and efficient code.	-	-	-	-
PC4. Understand to use Python for file handling operations such as reading from and writing to files.	-	-	-	-
PC5. Describe to use of Python libraries like NumPy and Pandas for basic data manipulation and analysis tasks.	-	-	-	-
PC6. Discuss basic debugging and error-handling techniques to identify and resolve issues in Python programs	-	-	-	-
Data Structures and Algorithms in Python	**10**	**15**	**-**	**3**
PC7. Understand the fundamentals data structures such as arrays, linked lists, stacks, queues, trees, and graphs in Python.	-	-	-	-
PC8. Describe to utilize Python's built-in data structures, such as lists, dictionaries, sets, and tuples, to solve problems effectively.	-	-	-	-
PC9. Discuss common algorithms for sorting (e.g., bubble sort, quicksort, mergesort) and searching (e.g., linear search, binary search) on various data structures.	-	-	-	-
PC10. Understand the concepts of complexity analysis, including time and space complexity, to evaluate the efficiency of algorithms.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC11. Describe recursion and its applications in solving problems, including tree traversal and backtracking algorithms.	-	-	-	-
PC12. Understand to solve practical problems and to utilize data structures to optimize performance in Python applications.	-	-	-	-
Object-Oriented Programming (OOP) in Python	**10**	**15**	**-**	**3**
PC13. Understand the core principles of Object-Oriented Programming (OOP), including encapsulation, inheritance, and polymorphism.	-	-	-	-
PC14. Define to use classes and objects in Python to model real-world entities and behaviors.	-	-	-	-
PC15. Discuss constructor and destructor methods to initialize and clean up object attributes in Python classes.	-	-	-	-
PC16. Understand to utilize class inheritance to create subclasses to extend or modify the functionality of parent classes.	-	-	-	-
PC17. Describe method overriding to customize the behavior of inherited methods in derived classes.	-	-	-	-
PC18. Discuss the concept of abstraction through abstract classes and interfaces to understand the design concept of flexible and modular code.	-	-	-	-
Libraries for AI and Data Science	**10**	**10**	**-**	**2**
PC19. Understand to use NumPy for numerical computations including array manipulation, mathematical operations and linear algebra.	-	-	-	-
PC20. Describe Pandas for data manipulation and analysis to utilize dataFrames for data cleaning, transformation and aggregation tasks.	-	-	-	-
PC21. Understand data visualization techniques using Matplotlib and Seaborn to create informative plots and graphs Seaborn.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC22. Discuss to utilize Scikit-learn for building and evaluating machine learning models, including data preprocessing, feature selection and model selection techniques.	-	-	-	-
PC23. Understand to use TensorFlow or PyTorch for developing and training deep learning models, including defining architectures and optimizing performance.	-	-	-	-
PC24. Discuss Natural Language Toolkit (NLTK) or spaCy for text processing tasks in Natural Language Processing (NLP), including tokenization, stemming and recognition.	-	-	-	-
NOS Total	**40**	**50**	**-**	**10**

National Occupational Standards (NOS) Parameters

NOS Code	ICE/ITS/N0202
NOS Name	Python Programming and data science for AI
Sector	Information Technology Sector
Sub-Sector	
Occupation	Artificial Intelligence
NSQF Level	5
Credits	3.5
Version	1.0
Last Reviewed Date	17/12/2024
Next Review Date	17/12/2027
NSQC Clearance Date	17/12/2024

ICE/ITS/N0203: Building Blocks of Artificial Intelligence (A.I)

Description

The Build Blocks of A.I. Specializations provide essential knowledge in AI concepts, algorithms, and methodologies across various domains, including machine learning and natural language processing, computer vision, Internet of things and Robotics.

Scope

The scope covers the following :

- Practical applications in diverse industries.
- Addresses ethical implications and responsible AI use.
- Fosters innovation to solve real-world problems with AI technologies.

Elements and Performance Criteria

Fundamentals of Machine Learning (ML)

To be competent, the user/individual on the job must be able to:

PC1. Explain the core concepts of supervised, unsupervised, and reinforcement learning.

PC2. Understand regression and classification models.

PC3. Discuss data preprocessing techniques, such as normalization and feature extraction to prepare data for ML models.

PC4. Explain key ML algorithms, such as decision trees, support vector machines, and k-means clustering.

PC5. Describe model performance using metrics like accuracy, precision, recall, F1-score, and ROC curves.

PC6. Understand model optimization techniques, including hyperparameter tuning and cross-validation.

Basics of Deep Learning

To be competent, the user/individual on the job must be able to:

PC7. Understand the core architecture of artificial neural networks (ANNs), including layers, nodes, and activation functions.

PC8. Discuss building and training feedforward neural networks using deep learning frameworks (e.g., TensorFlow, PyTorch).

PC9. Explain the concept of backpropagation and its role in optimizing neural networks.

PC10. Describe convolutional neural networks (CNNs) for image-related tasks such as classification and object detection.

PC11. Understand the basics of recurrent neural networks (RNNs) and their applications in sequence data like time series and natural language.

PC12. Understand to utilize regularization techniques to prevent overfitting in deep learning models.

Fundamentals of Natural Language Processing (NLP)

To be competent, the user/individual on the job must be able to:

PC13. Understand the basic concepts of tokenization, stemming, and lemmatization for text preprocessing.

PC14. Explain building and applying language models for text prediction and generation.

PC15. Explain the use of word embeddings (e.g., Word2Vec, GloVe) to represent text data as vectors in NLP tasks.

PC16. Describe NLP techniques for tasks such as sentiment analysis, text classification and named entity recognition (NER).

PC17. Understand sequence-to-sequence models for machine translation, summarization and other text-based tasks.

PC18. Understand to evaluate metrics like BLEU, ROUGE to assess the performance of NLP models.

Basics of Computer Vision

To be competent, the user/individual on the job must be able to:

PC19. Understand the key concepts of image processing such as filtering, edge detection and image enhancement.

PC20. Discuss building and applying Convolutional Neural Networks (CNNs) for tasks like image classification and object detection.

PC21. Describe techniques for image segmentation to separate objects or regions within an image.

PC22. Discuss image augmentation techniques to improve model generalization and performance on visual tasks.

PC23. Explain the principles of object tracking and motion detection in video processing.

PC24. Understand feature extraction methods like SIFT, SURF, and ORB for object recognition and computer vision applications.

Fundamentals of Internet of Things (IoT)

To be competent, the user/individual on the job must be able to:

PC25. Understand the basic architecture of IoT systems, including sensors, actuators, and communication protocols.

PC26. Explain to connect and configure IoT devices for data collection and monitoring.

PC27. Explain the role of edge computing and its integration with IoT to process data locally for faster responses.

PC28. Understand the principles of IoT communication protocols such as MQTT, CoAP, and HTTP, and their applications.

PC29. Describe data security and privacy concerns in IoT systems, including encryption and authentication techniques.

PC30. Describe IoT for smart systems design, such as smart homes, industrial automation, or environmental monitoring.

Basics of Robotics

To be competent, the user/individual on the job must be able to:

PC31. Explain the fundamental concepts of robot kinematics, including forward and inverse kinematics for robot movement and positioning.

PC32. Understand the programming robot control systems for tasks such as navigation, manipulation, and automation.

PC33. Discuss sensor integration (e.g., cameras, LIDAR, ultrasonic sensors) for robot perception and environment interaction.

PC34. Understand the basics of robot dynamics and forces and torques affect robot motion and stability.

PC35. Understand ability to implement robot path planning algorithms to enable autonomous navigation in dynamic environments.

PC36. Discuss robotic learning techniques, such as reinforcement learning, to improve robot decision-making and task execution.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. Basic concepts of machine learning, including different types of learning (supervised, unsupervised, and reinforcement) and their applications in various domains.

KU2. Deep learning architectures, including neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs), and their role in AI advancements.

KU3. Fundamental techniques and tools used in NLP, such as tokenization, stemming, and sentiment analysis, and their applications in text and speech processing.

KU4. Principles of computer vision, including image processing techniques, feature extraction, and object detection, along with their applications in industries like healthcare and automotive.

KU5. IoT concepts, including sensor integration, data collection, and the use of AI in smart devices for automation and enhanced decision-making.

KU6. Principles of robotics, including perception, decision-making, and control systems, and AI technologies are integrated to improve robot functionalities.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. Listen and communicate effectively and accurately.

GS2. Apply problem-solving approaches for different situations.

GS3. Work effectively in a team.

GS4. Employ proper time management.

GS5. Plan and organize work.

GS6. Maintain hygiene and sanitation.

GS7. Analytical Skills.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Fundamentals of Machine Learning (ML)	**7**	**9**	**-**	**2**
PC1. Explain the core concepts of supervised, unsupervised, and reinforcement learning.	-	-	-	-
PC2. Understand regression and classification models.	-	-	-	-
PC3. Discuss data preprocessing techniques, such as normalization and feature extraction to prepare data for ML models.	-	-	-	-
PC4. Explain key ML algorithms, such as decision trees, support vector machines, and k-means clustering.	-	-	-	-
PC5. Describe model performance using metrics like accuracy, precision, recall, F1-score, and ROC curves.	-	-	-	-
PC6. Understand model optimization techniques, including hyperparameter tuning and cross-validation.	-	-	-	-
Basics of Deep Learning	**7**	**9**	**-**	**2**
PC7. Understand the core architecture of artificial neural networks (ANNs), including layers, nodes, and activation functions.	-	-	-	-
PC8. Discuss building and training feedforward neural networks using deep learning frameworks (e.g., TensorFlow, PyTorch).	-	-	-	-
PC9. Explain the concept of backpropagation and its role in optimizing neural networks.	-	-	-	-
PC10. Describe convolutional neural networks (CNNs) for image-related tasks such as classification and object detection.	-	-	-	-
PC11. Understand the basics of recurrent neural networks (RNNs) and their applications in sequence data like time series and natural language.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC12. Understand to utilize regularization techniques to prevent overfitting in deep learning models.	-	-	-	-
Fundamentals of Natural Language Processing (NLP)	**7**	**8**	**-**	**2**
PC13. Understand the basic concepts of tokenization, stemming, and lemmatization for text preprocessing.	-	-	-	-
PC14. Explain building and applying language models for text prediction and generation.	-	-	-	-
PC15. Explain the use of word embeddings (e.g., Word2Vec, GloVe) to represent text data as vectors in NLP tasks.	-	-	-	-
PC16. Describe NLP techniques for tasks such as sentiment analysis, text classification and named entity recognition (NER).	-	-	-	-
PC17. Understand sequence-to-sequence models for machine translation, summarization and other text-based tasks.	-	-	-	-
PC18. Understand to evaluate metrics like BLEU, ROUGE to assess the performance of NLP models.	-	-	-	-
Basics of Computer Vision	**6**	**8**	**-**	**1**
PC19. Understand the key concepts of image processing such as filtering, edge detection and image enhancement.	-	-	-	-
PC20. Discuss building and applying Convolutional Neural Networks (CNNs) for tasks like image classification and object detection.	-	-	-	-
PC21. Describe techniques for image segmentation to separate objects or regions within an image.	-	-	-	-
PC22. Discuss image augmentation techniques to improve model generalization and performance on visual tasks.	-	-	-	-
PC23. Explain the principles of object tracking and motion detection in video processing.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC24. Understand feature extraction methods like SIFT, SURF, and ORB for object recognition and computer vision applications.	-	-	-	-
Fundamentals of Internet of Things (IoT)	**6**	**8**	**-**	**1**
PC25. Understand the basic architecture of IoT systems, including sensors, actuators, and communication protocols.	-	-	-	-
PC26. Explain to connect and configure IoT devices for data collection and monitoring.	-	-	-	-
PC27. Explain the role of edge computing and its integration with IoT to process data locally for faster responses.	-	-	-	-
PC28. Understand the principles of IoT communication protocols such as MQTT, CoAP, and HTTP, and their applications.	-	-	-	-
PC29. Describe data security and privacy concerns in IoT systems, including encryption and authentication techniques.	-	-	-	-
PC30. Describe IoT for smart systems design, such as smart homes, industrial automation, or environmental monitoring.	-	-	-	-
Basics of Robotics	**7**	**8**	**-**	**2**
PC31. Explain the fundamental concepts of robot kinematics, including forward and inverse kinematics for robot movement and positioning.	-	-	-	-
PC32. Understand the programming robot control systems for tasks such as navigation, manipulation, and automation.	-	-	-	-
PC33. Discuss sensor integration (e.g., cameras, LIDAR, ultrasonic sensors) for robot perception and environment interaction.	-	-	-	-
PC34. Understand the basics of robot dynamics and forces and torques affect robot motion and stability.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC35. Understand ability to implement robot path planning algorithms to enable autonomous navigation in dynamic environments.	-	-	-	-
PC36. Discuss robotic learning techniques, such as reinforcement learning, to improve robot decision-making and task execution.	-	-	-	-
NOS Total	**40**	**50**	**-**	**10**

National Occupational Standards (NOS) Parameters

NOS Code	ICE/ITS/N0203
NOS Name	Building Blocks of Artificial Intelligence (A.I)
Sector	Information Technology Sector
Sub-Sector	
Occupation	Artificial Intelligence
NSQF Level	5
Credits	3
Version	1.0
Last Reviewed Date	17/12/2024
Next Review Date	17/12/2027
NSQC Clearance Date	17/12/2024

Qualification Pack

DGT/VSQ/N0102: Employability Skills (60 Hours)

Description

This unit is about employability skills, Constitutional values, becoming a professional in the 21st Century, digital, financial, and legal literacy, diversity and Inclusion, English and communication skills, customer service, entrepreneurship, and apprenticeship, getting ready for jobs and career development.

Scope

The scope covers the following :

- Introduction to Employability Skills
- Constitutional values - Citizenship
- Becoming a Professional in the 21st Century
- Basic English Skills
- Career Development & Goal Setting
- Communication Skills
- Diversity & Inclusion
- Financial and Legal Literacy
- Essential Digital Skills
- Entrepreneurship
- Customer Service
- Getting ready for Apprenticeship & Jobs

Elements and Performance Criteria

Introduction to Employability Skills

To be competent, the user/individual on the job must be able to:

PC1. identify employability skills required for jobs in various industries

PC2. identify and explore learning and employability portals

Constitutional values – Citizenship

To be competent, the user/individual on the job must be able to:

PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.

PC4. follow environmentally sustainable practices

Becoming a Professional in the 21st Century

To be competent, the user/individual on the job must be able to:

PC5. recognize the significance of 21st Century Skills for employment

PC6. practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life

Basic English Skills

To be competent, the user/individual on the job must be able to:

PC7. use basic English for everyday conversation in different contexts, in person and over the telephone

PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English

PC9. write short messages, notes, letters, e-mails etc. in English

Career Development & Goal Setting

To be competent, the user/individual on the job must be able to:

PC10. understand the difference between job and career

PC11. prepare a career development plan with short- and long-term goals, based on aptitude

Communication Skills

To be competent, the user/individual on the job must be able to:

PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings

PC13. work collaboratively with others in a team

Diversity & Inclusion

To be competent, the user/individual on the job must be able to:

PC14. communicate and behave appropriately with all genders and PwD

PC15. escalate any issues related to sexual harassment at workplace according to POSH Act

Financial and Legal Literacy

To be competent, the user/individual on the job must be able to:

PC16. select financial institutions, products and services as per requirement

PC17. carry out offline and online financial transactions, safely and securely

PC18. identify common components of salary and compute income, expenses, taxes, investments etc

PC19. identify relevant rights and laws and use legal aids to fight against legal exploitation

Essential Digital Skills

To be competent, the user/individual on the job must be able to:

PC20. operate digital devices and carry out basic internet operations securely and safely

PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively

PC22. use basic features of word processor, spreadsheets, and presentations

Entrepreneurship

To be competent, the user/individual on the job must be able to:

PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research

PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion

PC25. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity

Customer Service

To be competent, the user/individual on the job must be able to:

PC26. identify different types of customers

PC27. identify and respond to customer requests and needs in a professional manner.

PC28. follow appropriate hygiene and grooming standards

Getting ready for apprenticeship & Jobs

To be competent, the user/individual on the job must be able to:

PC29. create a professional Curriculum vitae (Résumé)

PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively

PC31. apply to identified job openings using offline /online methods as per requirement

PC32. answer questions politely, with clarity and confidence, during recruitment and selection

PC33. identify apprenticeship opportunities and register for it as per guidelines and requirements

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. need for employability skills and different learning and employability related portals

KU2. various constitutional and personal values

KU3. different environmentally sustainable practices and their importance

KU4. Twenty first (21st) century skills and their importance

KU5. how to use English language for effective verbal (face to face and telephonic) and written communication in formal and informal set up

KU6. importance of career development and setting long- and short-term goals

KU7. about effective communication

KU8. POSH Act

KU9. Gender sensitivity and inclusivity

KU10. different types of financial institutes, products, and services

KU11. how to compute income and expenditure

KU12. importance of maintaining safety and security in offline and online financial transactions

KU13. different legal rights and laws

KU14. different types of digital devices and the procedure to operate them safely and securely

KU15. how to create and operate an e- mail account and use applications such as word processors, spreadsheets etc.

KU16. how to identify business opportunities

KU17. types and needs of customers

KU18. how to apply for a job and prepare for an interview

KU19. apprenticeship scheme and the process of registering on apprenticeship portal

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. read and write different types of documents/instructions/correspondence

GS2. communicate effectively using appropriate language in formal and informal settings

GS3. behave politely and appropriately with all
GS4. how to work in a virtual mode
GS5. perform calculations efficiently
GS6. solve problems effectively
GS7. pay attention to details
GS8. manage time efficiently
GS9. maintain hygiene and sanitization to avoid infection

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Introduction to Employability Skills	**1**	**1**	**-**	**-**
PC1. identify employability skills required for jobs in various industries	-	-	-	-
PC2. identify and explore learning and employability portals	-	-	-	-
Constitutional values – Citizenship	**1**	**1**	**-**	**-**
PC3. recognize the significance of constitutional values, including civic rights and duties, citizenship, responsibility towards society etc. and personal values and ethics such as honesty, integrity, caring and respecting others, etc.	-	-	-	-
PC4. follow environmentally sustainable practices	-	-	-	-
Becoming a Professional in the 21st Century	**2**	**4**	**-**	**-**
PC5. recognize the significance of 21st Century Skills for employment	-	-	-	-
PC6. practice the 21st Century Skills such as Self-Awareness, Behaviour Skills, time management, critical and adaptive thinking, problem-solving, creative thinking, social and cultural awareness, emotional awareness, learning to learn for continuous learning etc. in personal and professional life	-	-	-	-
Basic English Skills	**2**	**3**	**-**	**-**
PC7. use basic English for everyday conversation in different contexts, in person and over the telephone	-	-	-	-
PC8. read and understand routine information, notes, instructions, mails, letters etc. written in English	-	-	-	-
PC9. write short messages, notes, letters, e-mails etc. in English	-	-	-	-
Career Development & Goal Setting	**1**	**2**	**-**	**-**

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC10. understand the difference between job and career	-	-	-	-
PC11. prepare a career development plan with short- and long-term goals, based on aptitude	-	-	-	-
Communication Skills	**2**	**2**	**-**	**-**
PC12. follow verbal and non-verbal communication etiquette and active listening techniques in various settings	-	-	-	-
PC13. work collaboratively with others in a team	-	-	-	-
Diversity & Inclusion	**1**	**2**	**-**	**-**
PC14. communicate and behave appropriately with all genders and PwD	-	-	-	-
PC15. escalate any issues related to sexual harassment at workplace according to POSH Act	-	-	-	-
Financial and Legal Literacy	**2**	**3**	**-**	**-**
PC16. select financial institutions, products and services as per requirement	-	-	-	-
PC17. carry out offline and online financial transactions, safely and securely	-	-	-	-
PC18. identify common components of salary and compute income, expenses, taxes, investments etc	-	-	-	-
PC19. identify relevant rights and laws and use legal aids to fight against legal exploitation	-	-	-	-
Essential Digital Skills	**3**	**4**	**-**	**-**
PC20. operate digital devices and carry out basic internet operations securely and safely	-	-	-	-
PC21. use e- mail and social media platforms and virtual collaboration tools to work effectively	-	-	-	-
PC22. use basic features of word processor, spreadsheets, and presentations	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Entrepreneurship	**2**	**3**	**-**	**-**
PC23. identify different types of Entrepreneurship and Enterprises and assess opportunities for potential business through research	-	-	-	-
PC24. develop a business plan and a work model, considering the 4Ps of Marketing Product, Price, Place and Promotion	-	-	-	-
PC25. identify sources of funding, anticipate, and mitigate any financial/ legal hurdles for the potential business opportunity	-	-	-	-
Customer Service	**1**	**2**	**-**	**-**
PC26. identify different types of customers	-	-	-	-
PC27. identify and respond to customer requests and needs in a professional manner.	-	-	-	-
PC28. follow appropriate hygiene and grooming standards	-	-	-	-
Getting ready for apprenticeship & Jobs	**2**	**3**	**-**	**-**
PC29. create a professional Curriculum vitae (Résumé)	-	-	-	-
PC30. search for suitable jobs using reliable offline and online sources such as Employment exchange, recruitment agencies, newspapers etc. and job portals, respectively	-	-	-	-
PC31. apply to identified job openings using offline /online methods as per requirement	-	-	-	-
PC32. answer questions politely, with clarity and confidence, during recruitment and selection	-	-	-	-
PC33. identify apprenticeship opportunities and register for it as per guidelines and requirements	-	-	-	-
NOS Total	**20**	**30**	**-**	**-**

National Occupational Standards (NOS) Parameters

NOS Code	DGT/VSQ/N0102
NOS Name	Employability Skills (60 Hours)
Sector	Cross Sectoral
Sub-Sector	Professional Skills
Occupation	Employability
NSQF Level	4
Credits	2
Version	1.0
Last Reviewed Date	22/07/2026
Next Review Date	22/07/2029
NSQC Clearance Date	22/07/2026

ICE/ITS/N0207: Applications of AI tools/algorithms in Mechanical Engineering

Description

This module addresses the applications of AI tools and algorithms in mechanical engineering, emphasizing the optimization of design and manufacturing processes, the enhancement of system performance, and the use of predictive analytics to facilitate better decision-making.

Scope

The scope covers the following :

- Integration of AI in product design and development.
- Optimization of manufacturing processes using AI algorithms.
- Implementation of predictive maintenance strategies for machinery.
- Application of AI in control systems and automation.
- Development of smart machinery for improved energy efficiency.
- Enhancements in sustainability practices within mechanical engineering applications.

Elements and Performance Criteria

Utilize AI tools /algorithms in Product Development

To be competent, the user/individual on the job must be able to:

PC1. Understand AI algorithms to enhance product design processes by optimizing mechanical components for efficiency, performance and cost-effectiveness based on multiple design parameters and constraints.

PC2. Discuss AI tools to generate innovative design solutions automatically, exploring a wide range of design options for mechanical systems that humans might not easily envision, thus fostering innovation in product development.

PC3. Describe AI to predict product performance by running simulations, such as stress tests and fatigue analysis, allowing for early identification of design flaws and reducing the need for physical prototypes.

PC4. ExplainAI algorithms to analyze material properties and performance, helping engineers select the most appropriate materials for product development based on desired characteristics like durability, weight, and cost.

PC5. Explore AI tools to streamline the prototyping process by integrating AI-driven 3D printing and manufacturing simulations, reducing lead time and costs associated with traditional prototyping.

PC6. Understand AI for analyzing data from product testing to improve design iterations, identifying areas for refinement and predicting potential failure modes to enhance product reliability and lifecycle performance.

Use AI tools /algorithms in Manufacturing and Production Systems

To be competent, the user/individual on the job must be able to:

PC7. Discuss AI algorithms to predict when machinery or equipment is likely to fail, enabling proactive maintenance scheduling that minimizes downtime and extends equipment lifespan.

PC8. Understand AI tools to optimize manufacturing processes by analyzing production data in real- time, reducing inefficiencies, improving throughput, and minimizing waste in production systems.

PC9. Describe AI with robotics in manufacturing to automate complex tasks, enhance precision, and adapt to changes in production needs, leading to increased efficiency and flexibility in production lines.

PC10. Explain AI-driven visual inspection systems to automatically detect defects and ensure consistent quality in manufactured products, reducing human error and improving product reliability.

PC11. Explore AI tools for demand forecasting and inventory management to optimize the supply chain, ensuring timely delivery of raw materials and minimizing production delays.

PC12. Understand AI to create adaptive manufacturing systems that adjust parameters, such as temperature, speed, or pressure, autonomously in response to real-time feedback, ensuring optimal production conditions.

Utilize AI tools /algorithms in Predictive Maintenance and Reliability Engineering

To be competent, the user/individual on the job must be able to:

PC13. Discuss AI tools to continuously monitor equipment conditions using sensors and data analytics, identifying abnormal patterns in vibration, temperature, and other key parameters to predict potential failures.

PC14. Understand AI algorithms to develop predictive models that forecast when mechanical components are likely to fail based on historical data, usage patterns, and operational conditions, allowing for timely maintenance.

PC15. Explain machine learning techniques to analyze large datasets from equipment operations, enabling data-driven insights to improve reliability, optimize maintenance schedules, and reduce unexpected breakdowns.

PC16. Understand AI-powered anomaly detection systems to automatically detect deviations from normal operational behavior in machinery, signaling early signs of wear, degradation, or potential failure.

PC17. Explore AI tools to optimize maintenance planning by predicting the most effective times for repairs or replacements, balancing cost and minimizing downtime, and extending the operational life of assets.

PC18. Explore AI algorithms to perform automated root cause analysis, identifying the underlying causes of equipment failures more quickly and accurately, improving future reliability and performance.

Use AI tools /algorithms in Control Systems and Automation

To be competent, the user/individual on the job must be able to:

PC19. Understand AI algorithms to create adaptive control systems that autonomously adjust operational parameters in real-time based on changes in environmental conditions, load, or process requirements, optimizing performance and efficiency.

PC20. Explain AI-based predictive models to anticipate future system behavior and adjust control actions accordingly, improving response times and minimizing errors in automated processes.

PC21. Explore AI tools to enable control systems that self-optimize through continuous learning from operational data, improving accuracy and reducing manual interventions in automation processes.

PC22. Discuss AI algorithms to detect faults and anomalies in control systems, enabling real-time diagnosis and automatic corrective actions that prevent system failure or downtime in automated processes.

PC23. Describe AI into automation systems to improve robustness and flexibility, allowing machines to handle complex tasks with minimal human oversight, adapt to changing production needs, and reduce operational inefficiencies.

PC24. Explore AI tools to analyze control system data and optimize energy consumption by adjusting control parameters to ensure energy-efficient operation without compromising performance.

Utilize AI tools /algorithms in Fluid Mechanics and Thermal Systems

To be competent, the user/individual on the job must be able to:

PC25. Discuss AI algorithms to predict complex flow patterns in fluid systems, enhancing the design and optimization of pipelines, HVAC systems and fluid transport in various engineering applications.

PC26. Describe AI tools to optimize the performance of thermal systems, such as heat exchangers or refrigeration units, by analyzing system data to improve heat transfer efficiency and energy consumption.

PC27. Understand AI with CFD simulations to reduce computational time and cost, while increasing the accuracy of simulations for fluid flow, pressure distribution and thermal management.

PC28. Discuss AI algorithms to continuously monitor fluid and thermal systems in real time, detecting anomalies or inefficiencies in the system and providing predictive maintenance insights.

PC29. Discuss AI tools to analyze operational data in thermal systems and adjust control parameters to improve energy efficiency, reducing operational costs and environmental impact.

PC30. Explain AI-driven optimization techniques to improve the design of pumps, turbines, compressors, and other fluid mechanics components, ensuring better performance under various conditions.

Use AI tools /algorithms in Energy Systems and Sustainability

To be competent, the user/individual on the job must be able to:

PC31. Discuss AI algorithms to analyze energy usage patterns in mechanical systems, optimizing operational processes to reduce overall energy consumption and increase energy efficiency.

PC32. Understand AI tools to improve the integration of renewable energy sources (solar, wind, etc.) into existing energy systems by predicting energy availability and optimizing energy storage and distribution.

PC33. Explain AI for real-time monitoring and optimization of smart grids, ensuring efficient energy distribution, load balancing and minimizing energy losses in large-scale energy systems.

PC34. Describe AI-driven predictive maintenance techniques to monitor the health of energy systems, detecting potential failures early and reducing downtime, which enhances system reliability and sustainability.

PC35. Explore AI tools to identify inefficiencies and recommend improvements in mechanical processes, reducing waste and emissions, and enhancing the overall sustainability of energy systems.

PC36. Understand AI to optimize energy storage systems, such as batteries and thermal storage units, improving charge/discharge cycles, extending system lifespan, and ensuring energy availability when demand is high.

Utilize AI tools /algorithms in Materials Science and Additive Manufacturing

To be competent, the user/individual on the job must be able to:

PC37. Discuss AI algorithms to predict the properties of new materials based on their composition and processing conditions, enabling the design of advanced materials with tailored characteristics for specific applications.

PC38. Understand AI tools to optimize parameters in additive manufacturing processes (such as 3D printing), enhancing print quality, reducing defects, and minimizing material waste.

PC39. Describe machine learning techniques to analyze large datasets from experimental and computational studies, accelerating the discovery of new materials with desirable properties for mechanical applications.

PC40. Explain AI for real-time monitoring and control of additive manufacturing processes, ensuring consistent product quality and enabling immediate adjustments to parameters to reduce variability.

PC41. Discuss AI algorithms to conduct life cycle assessments of materials and manufacturing processes, identifying opportunities for reducing environmental impact and promoting sustainable practices in materials science.

PC42. Understand AI techniques to predict potential failures in materials based on stress and strain data, enabling proactive maintenance strategies and improving the reliability and safety of mechanical components.

Advancement in AI for Mechanical Engineering

To be competent, the user/individual on the job must be able to:

PC43. Explore advanced machine learning algorithms to analyze historical design data, enabling the identification of design patterns that lead to innovative product developments in mechanical engineering.

PC44. Understand AI technologies to improve robotic systems in manufacturing and assembly lines, enhancing their capabilities in adaptive learning, object recognition, and task execution.

PC45. Discuss AI-driven data analytics to optimize manufacturing processes, allowing for real-time adjustments based on performance data, leading to increased productivity and reduced operational costs.

PC46. Explain research and develop AI-integrated smart materials that change properties in response to environmental conditions, enabling the creation of adaptive systems in mechanical applications such as aerospace and automotive engineering.

PC47. Explore AI technologies in simulation tools to create virtual prototypes that predict mechanical behavior under various scenarios.

Knowledge and Understanding (KU)

The individual on the job needs to know and understand:

KU1. AI algorithms analyze equipment data to predict failures, enabling proactive maintenance and reducing downtime in mechanical systems.

KU2. AI techniques that assist in optimizing design parameters, leading to more efficient and innovative product designs in mechanical engineering.

KU3. AI applications in robotics, including machine learning and computer vision, to enhance the capabilities of automated systems in manufacturing and assembly processes.

KU4. AI is employed to simulate and analyze fluid flow and thermal behavior in various mechanical systems, improving efficiency and performance.

KU5. Role of AI in optimizing energy consumption and performance in mechanical systems, such as HVAC and renewable energy systems.

KU6. AI-enhanced FEA tools that improve the accuracy of simulations for stress, strain, and thermal analysis in mechanical components.

KU7. AI applications in real-time monitoring and control of manufacturing processes, enabling increased efficiency, quality, and reduced waste.

KU8. AI optimizes designs specifically for additive manufacturing processes.

KU9. Intersection of AI and IoT, enabling smart mechanical systems.

Generic Skills (GS)

User/individual on the job needs to know how to:

GS1. Listen and communicate effectively and accurately.

GS2. Apply problem-solving approaches for different situations.

GS3. Work effectively in a team.

GS4. Employ proper time management

GS5. Plan and organize work

GS6. Maintain hygiene and sanitation.

GS7. Analytical skills.

Assessment Criteria

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
Utilize AI tools /algorithms in Product Development	**5**	**6**	**-**	**2**
PC1. Understand AI algorithms to enhance product design processes by optimizing mechanical components for efficiency, performance and cost-effectiveness based on multiple design parameters and constraints.	-	-	-	-
PC2. Discuss AI tools to generate innovative design solutions automatically, exploring a wide range of design options for mechanical systems that humans might not easily envision, thus fostering innovation in product development.	-	-	-	-
PC3. Describe AI to predict product performance by running simulations, such as stress tests and fatigue analysis, allowing for early identification of design flaws and reducing the need for physical prototypes.	-	-	-	-
PC4. ExplainAI algorithms to analyze material properties and performance, helping engineers select the most appropriate materials for product development based on desired characteristics like durability, weight, and cost.	-	-	-	-
PC5. Explore AI tools to streamline the prototyping process by integrating AI-driven 3D printing and manufacturing simulations, reducing lead time and costs associated with traditional prototyping.	-	-	-	-
PC6. Understand AI for analyzing data from product testing to improve design iterations, identifying areas for refinement and predicting potential failure modes to enhance product reliability and lifecycle performance.	-	-	-	-
Use AI tools /algorithms in Manufacturing and Production Systems	**5**	**6**	**-**	**2**
PC7. Discuss AI algorithms to predict when machinery or equipment is likely to fail, enabling proactive maintenance scheduling that minimizes downtime and extends equipment lifespan.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC8. Understand AI tools to optimize manufacturing processes by analyzing production data in real- time, reducing inefficiencies, improving throughput, and minimizing waste in production systems.	-	-	-	-
PC9. Describe AI with robotics in manufacturing to automate complex tasks, enhance precision, and adapt to changes in production needs, leading to increased efficiency and flexibility in production lines.	-	-	-	-
PC10. Explain AI-driven visual inspection systems to automatically detect defects and ensure consistent quality in manufactured products, reducing human error and improving product reliability.	-	-	-	-
PC11. Explore AI tools for demand forecasting and inventory management to optimize the supply chain, ensuring timely delivery of raw materials and minimizing production delays.	-	-	-	-
PC12. Understand AI to create adaptive manufacturing systems that adjust parameters, such as temperature, speed, or pressure, autonomously in response to real-time feedback, ensuring optimal production conditions.	-	-	-	-
Utilize AI tools /algorithms in Predictive Maintenance and Reliability Engineering	**5**	**6**	**-**	**1**
PC13. Discuss AI tools to continuously monitor equipment conditions using sensors and data analytics, identifying abnormal patterns in vibration, temperature, and other key parameters to predict potential failures.	-	-	-	-
PC14. Understand AI algorithms to develop predictive models that forecast when mechanical components are likely to fail based on historical data, usage patterns, and operational conditions, allowing for timely maintenance.	-	-	-	-
PC15. Explain machine learning techniques to analyze large datasets from equipment operations, enabling data-driven insights to improve reliability, optimize maintenance schedules, and reduce unexpected breakdowns.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC16. Understand AI-powered anomaly detection systems to automatically detect deviations from normal operational behavior in machinery, signaling early signs of wear, degradation, or potential failure.	-	-	-	-
PC17. Explore AI tools to optimize maintenance planning by predicting the most effective times for repairs or replacements, balancing cost and minimizing downtime, and extending the operational life of assets.	-	-	-	-
PC18. Explore AI algorithms to perform automated root cause analysis, identifying the underlying causes of equipment failures more quickly and accurately, improving future reliability and performance.	-	-	-	-
Use AI tools /algorithms in Control Systems and Automation	**5**	**7**	**-**	**1**
PC19. Understand AI algorithms to create adaptive control systems that autonomously adjust operational parameters in real-time based on changes in environmental conditions, load, or process requirements, optimizing performance and efficiency.	-	-	-	-
PC20. Explain AI-based predictive models to anticipate future system behavior and adjust control actions accordingly, improving response times and minimizing errors in automated processes.	-	-	-	-
PC21. Explore AI tools to enable control systems that self-optimize through continuous learning from operational data, improving accuracy and reducing manual interventions in automation processes.	-	-	-	-
PC22. Discuss AI algorithms to detect faults and anomalies in control systems, enabling real-time diagnosis and automatic corrective actions that prevent system failure or downtime in automated processes.	-	-	-	-
PC23. Describe AI into automation systems to improve robustness and flexibility, allowing machines to handle complex tasks with minimal human oversight, adapt to changing production needs, and reduce operational inefficiencies.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC24. Explore AI tools to analyze control system data and optimize energy consumption by adjusting control parameters to ensure energy-efficient operation without compromising performance.	-	-	-	-
Utilize AI tools /algorithms in Fluid Mechanics and Thermal Systems	**5**	**7**	**-**	**1**
PC25. Discuss AI algorithms to predict complex flow patterns in fluid systems, enhancing the design and optimization of pipelines, HVAC systems and fluid transport in various engineering applications.	-	-	-	-
PC26. Describe AI tools to optimize the performance of thermal systems, such as heat exchangers or refrigeration units, by analyzing system data to improve heat transfer efficiency and energy consumption.	-	-	-	-
PC27. Understand AI with CFD simulations to reduce computational time and cost, while increasing the accuracy of simulations for fluid flow, pressure distribution and thermal management.	-	-	-	-
PC28. Discuss AI algorithms to continuously monitor fluid and thermal systems in real time, detecting anomalies or inefficiencies in the system and providing predictive maintenance insights.	-	-	-	-
PC29. Discuss AI tools to analyze operational data in thermal systems and adjust control parameters to improve energy efficiency, reducing operational costs and environmental impact.	-	-	-	-
PC30. Explain AI-driven optimization techniques to improve the design of pumps, turbines, compressors, and other fluid mechanics components, ensuring better performance under various conditions.	-	-	-	-
Use AI tools /algorithms in Energy Systems and Sustainability	**5**	**6**	**-**	**1**
PC31. Discuss AI algorithms to analyze energy usage patterns in mechanical systems, optimizing operational processes to reduce overall energy consumption and increase energy efficiency.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC32. Understand AI tools to improve the integration of renewable energy sources (solar, wind, etc.) into existing energy systems by predicting energy availability and optimizing energy storage and distribution.	-	-	-	-
PC33. Explain AI for real-time monitoring and optimization of smart grids, ensuring efficient energy distribution, load balancing and minimizing energy losses in large-scale energy systems.	-	-	-	-
PC34. Describe AI-driven predictive maintenance techniques to monitor the health of energy systems, detecting potential failures early and reducing downtime, which enhances system reliability and sustainability.	-	-	-	-
PC35. Explore AI tools to identify inefficiencies and recommend improvements in mechanical processes, reducing waste and emissions, and enhancing the overall sustainability of energy systems.	-	-	-	-
PC36. Understand AI to optimize energy storage systems, such as batteries and thermal storage units, improving charge/discharge cycles, extending system lifespan, and ensuring energy availability when demand is high.	-	-	-	-
Utilize AI tools /algorithms in Materials Science and Additive Manufacturing	**5**	**6**	**-**	**1**
PC37. Discuss AI algorithms to predict the properties of new materials based on their composition and processing conditions, enabling the design of advanced materials with tailored characteristics for specific applications.	-	-	-	-
PC38. Understand AI tools to optimize parameters in additive manufacturing processes (such as 3D printing), enhancing print quality, reducing defects, and minimizing material waste.	-	-	-	-
PC39. Describe machine learning techniques to analyze large datasets from experimental and computational studies, accelerating the discovery of new materials with desirable properties for mechanical applications.	-	-	-	-

Assessment Criteria for Outcomes	Theory Marks	Practical Marks	Project Marks	Viva Marks
PC40. Explain AI for real-time monitoring and control of additive manufacturing processes, ensuring consistent product quality and enabling immediate adjustments to parameters to reduce variability.	-	-	-	-
PC41. Discuss AI algorithms to conduct life cycle assessments of materials and manufacturing processes, identifying opportunities for reducing environmental impact and promoting sustainable practices in materials science.	-	-	-	-
PC42. Understand AI techniques to predict potential failures in materials based on stress and strain data, enabling proactive maintenance strategies and improving the reliability and safety of mechanical components.	-	-	-	-
Advancement in AI for Mechanical Engineering	**5**	**6**	**-**	**1**
PC43. Explore advanced machine learning algorithms to analyze historical design data, enabling the identification of design patterns that lead to innovative product developments in mechanical engineering.	-	-	-	-
PC44. Understand AI technologies to improve robotic systems in manufacturing and assembly lines, enhancing their capabilities in adaptive learning, object recognition, and task execution.	-	-	-	-
PC45. Discuss AI-driven data analytics to optimize manufacturing processes, allowing for real-time adjustments based on performance data, leading to increased productivity and reduced operational costs.	-	-	-	-
PC46. Explain research and develop AI-integrated smart materials that change properties in response to environmental conditions, enabling the creation of adaptive systems in mechanical applications such as aerospace and automotive engineering.	-	-	-	-
PC47. Explore AI technologies in simulation tools to create virtual prototypes that predict mechanical behavior under various scenarios.	-	-	-	-
NOS Total	**40**	**50**	**-**	**10**

National Occupational Standards (NOS) Parameters

NOS Code	ICE/ITS/N0207
NOS Name	Applications of AI tools/algorithms in Mechanical Engineering
Sector	Information Technology Sector
Sub-Sector	
Occupation	Artificial Intelligence
NSQF Level	5
Credits	10
Version	1.0
Last Reviewed Date	17/12/2024
Next Review Date	17/12/2027
NSQC Clearance Date	17/12/2024

Assessment Guidelines and Assessment Weightage

Assessment Guidelines

Criteria for assessment for each Qualification Pack will be created by the Awarding Body. Each Performance Criteria (PC)/ Element will be assigned marks proportional to its importance in NOS. AB will also lay down proportion of marks for Theory and Skills Practical for each PC/ Element.

2. The assessment for the knowledge part will be based on knowledge bank of questions created by Assessment Bodies subject to approval by AB

3. Individual assessment agencies will create unique question papers for knowledge/theory part for assessment of candidates as per assessment criteria given below

4. Individual assessment agencies will create unique evaluations for skill practical for every student at each examination/training center based on assessment criteria.

5. The passing percentage for each QP will be 70%. To pass the Qualification Pack, every trainee should score a minimum of 70% individually in each NOS.

6. The Assessor shall check the final outcome of the practices while evaluating the steps performed to achieve the final outcome.

7. The trainee shall be provided with a chance to repeat the test to correct his procedures in case of improper performance, with a deduction of marks for each iteration.

8. After the certain number of iterations as decided by AB the trainee is marked as fail, scoring zero marks for the procedure for the practical activity.

9. In case of successfully passing only certain number of NOS's, the trainee is eligible to take subsequent assessment on the balance NOS's to pass the Qualification Pack within the specified time frame set by AB.

10. Minimum duration of Assessment of each QP shall be of 4hrs/trainee

Minimum Aggregate Passing % at QP Level : 70

(**Please note**: Every Trainee should score a minimum aggregate passing percentage as specified above, to successfully clear the Qualification Pack assessment.)

Assessment Weightage

Compulsory NOS

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ICE/ITS/N0201.Fundamentals of Artificial Intelligence (AI)	40	50	0	10	100	15
ICE/ITS/N0202.Python Programming and data science for AI	40	50	0	10	100	30
ICE/ITS/N0203.Building Blocks of Artificial Intelligence (A.I)	40	50	-	10	100	15
DGT/VSQ/N0102.Employability Skills (60 Hours)	20	30	-	-	50	10
Total	**140**	**180**	**-**	**30**	**350**	**70**

Elective: 1 Applications of AI in Mechanical Domain

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
ICE/ITS/N0207.Applications of AI tools/algorithms in Mechanical Engineering	40	50	0	10	100	30

Qualification Pack

National Occupational Standards	Theory Marks	Practical Marks	Project Marks	Viva Marks	Total Marks	Weightage
Total	**40**	**50**	**-**	**10**	**100**	**30**