Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Kamyab Jawan Program
"Skills for All"

Course Contents/ Lesson Plan
Course Title: Artificial Intelligence (Robotics)
Duration: 6 Months

Trainer Name	Muhammad Rizwan
Course Title	**Artificial Intelligence (Robotics)**
Objective of Course	**Employable skills and hands on practice for Artificial Intelligence, including specialization in Machine Learning, Deep Learning & Robotics**

The aim for the team of staff responsible for delivery of the advanced IT curriculum is to provide knowledge and develop skills related to the IT. The course will allow participants to gain a comprehensive understanding of all the aspects. It will also develop the participant's ability to act in a professional and responsible manner.

Teaching staff will provide the technical knowledge and abilities required to solve tasks and problems that are goal-oriented. They will use participant-centered, practically oriented methods. They will also develop a program of practical assessment that reflects the learning outcomes stated in the curriculum. Trainees of the IT curriculum will also develop their willingness and ability as individuals to clarify issues, as well as think through and assess development opportunities.

Teaching staff will also support trainees in developing characteristics such as self-reliance, reliability, responsibility, a sense of duty and a willingness and ability to criticize and accept criticism well and to adapt their future behavior accordingly.

Teaching staff also use the IT curriculum to address the development of professional competence. Trainees will acquire the ability to work in a professional environment.

By the end of this course, the trainees should gain the following competencies:

- Understanding of core concepts of artificial intelligence and machine learning
- State of the art machine learning techniques
- Hands-on exposure to exploratory data analysis
- Practical exposure to model design, evaluation
- Familiarity with tools and libraries such as scikit learn, python, sql, pandas numpy, tensorflow, pytorch, keras and robotics

Learning Outcome of the Course	After taking this course, you will be familiar with the fundamentals of Artificial Intelligence. You will gain practical experience in applying AI for problem solving, and will develop a deep understanding of the core concepts by implementing solutions to real world problems. By the end of this course, the trainees should gain the following competencies: - Understanding of core concepts of artificial intelligence and machine learning - State of the art deep learning techniques - Hands-on exposure to exploratory data analysis - Practical exposure to model design, evaluation - Familiarity with tools and libraries such as scikit learn, python, sql, pandas numpy, tensorflow, pytorch, keras and robotics - Hand-on experience on visual data analysis
Companies Offering Jobs in the respective trade	1. Careem 2. Afiniti 3. Addo.ai 4. Arbisoft 5. I2c 6. xavor 7. Fiverivers Technologies 8. confiz 9. Crossover 10. NetSol 11. Research institutes 12. All Private Institutes who have an ML department
Job Opportunities	AI is the buzzword of the century, attracting attention across industries, motivating changes in products as well as services. It is the very nature of the subject that makes its applications infinite, in multiple domains. Whether you belong to a technical background or not, chances are that AI can make your job easier, and push it in the right direction. Dive in to develop an understanding of the core concepts, while gaining hands on experience and training from the industry's finest. Trained resources can find work as one of the following roles • AI Engineer • Machine Learning Engineer • Data Analyst • Research Assistant • Python Programmer • Deep Learning Engineer • IoT Engineer
No of Students	20-24

Learning Place	Classroom / Lab
Instructional Resources	**Development Platform:** • https://github.com/ , • https://www.anaconda.com/distribution/ • https://www.jetbrains.com/pycharm/ • https://jupyter.org/ **Frameworks and Libraries:** • https://www.tensorflow.org/ • http://keras.io/ • https://pytorch.org/ • https://caffe.berkeleyvision.org/ **Learning Material:** • https://www.kaggle.com/ • https://www.youtube.com/watch?v=UzxYlbK2c7E • https://www.youtube.com/watch?v=UzxYlbK2c7E&list=PLA89DCFA6ADACE599

Scheduled Week	Module Title	Learning Units	Remarks

Week 1	➢ Introduction	• **Motivational Lecture**
		• **Course Introduction**
		• **Success stories**
		• **Job market**
		• **Course Applications**
		• **Institute/work ethics**
		• Introduction to Artificial Intelligence
		• A brief history of AI
		• AI terminology
		• State of the art techniques
		• Lab
		  o Anaconda installation
		  o Setting up environment and introducing Jupyter notebook
		  o Introduction to Python	

Week 2	**Part – 1 AI Fundamentals and Programming**
	
	Chapter 1 AI & Python Fundamentals
		AI for Everyone
		  o Python Introduction
		  o Python data types, conditional statements, loops
		  o Functions & Modules	

Week 3	**Chapter 2**
	Python Object Oriented Programming
		• Decorators, Generators
		• Classes & Objects
		  o Inheritance
		  o Encapsulation
		  o Polymorphism	

Week 4	**Chapter 3**
	Python for Data Science
		• Data science introduction
		  o NumPy
		  o Pandas
		  o Matplotlib
		  o Seaborn	

Week 5	**Part – 2 AI and Machine Learning** **Chapter 4** Machine Learning Fundamentals	- What is Data - What is Machine Learning - Supervised vs. Unsupervised learning - Evaluation - Train-Test split - Validation	
Week 6	**Chapter 5** Regression	- Regression - Univariate linear regression - Multivariate regression - Polynomial regression	
Week 7	**Chapter 6** Classification	- Algorithms - Logistic Regression - KNN - Naïve Bayes - Decision Trees - SVMs	
Week 8	**Chapter 7** Clustering	- Clustering - Classification vs. Clustering - K-means Clustering - Hierarchical Clustering	
Week 9	**Chapter 8** Time Series Analysis	- Time Series Analysis - Hidden Markov Models	
Week 10	**Chapter 9** Neural Networks	- Introduction to Neural Networks - MLP - Feed Forward neural networks	
Week 11	**Chapter 10** Neural Networks – Part 2	- Neural Networks - Backpropagation - Activation Functions - Loss Function - Optimization|	

Part – 3 Deep Learning

Scheduled Week	Module Title	Learning Units	Remarks
Week 12	**Chapter 11** Introduction to computer vision	• Images • Image enhancement • Data loading	
Week 13	**Chapter 12** Filtering	• Spatial filtering • Noise models	

Week 14	**Chapter 13** Morphology	• Morphology
		   o Fitting
		   o Hitting
		   o Region filling
		   o Boundary Extraction
		   o Extraction of connected components
		   o Thinning and Thickening
		   o Erosion
		   o Dilation	

Week 15		**Mid-Term Assignment**	
Week 16	**Chapter 14** Natural Language Processing	• Sequence Modelling o NLP Deep Learning Models	

Week 17	**Chapter 15** Deep Neural Networks – Part 1	• Deep Neural Networks
		   o Layers
		   o Architecture
		   o Hyperparameters	

Week 18	**Chapter 16** Deep Neural Networks – Part 2	• Deep Neural Networks o CNNs	

Week 19	**Chapter 17** Deep Neural Networks – Part 3	• Deep Neural Networks
		   • RNNs
		   • LSTMs	

Week 20	**Chapter 18** Deep Neural Networks – Part 4	• Deep Neural Networks • 3D CNNs	
Week 21	**Chapter 19** Employable Project/Assignment (6 weeks i.e 21-26) in addition of regular classes.	● Guidelines to the Trainees for selection of students employable project like final year project (FYP) ● Assign Independent project to each Trainee ● A project based on trainee's aptitude and acquired skills. ● Designed by keeping in view the emerging trends in the local market as well as across the globe. ● The project idea may be based on Entrepreneur. ● Leading to the successful employment. ● The duration of the project will be 6 weeks ● Ideas may be generated via different sites such as: https://1000projects.org/ https://nevonprojects.com/ https://www.freestudentprojects.com/ https://technofizi.net/best-computer-science-and-engineering-cse-project-topics-ideas-for-students/ • Final viva/assessment will be conducted on project assignments. • At the end of session the project will be presented in skills competition • The skill competition will be conducted on zonal, regional and National level. • The project will be presented in front of Industrialists for commercialization	
Week 22	**Chapter 20** Generative Adversarial Networks – Part 1	• Introducing GANs • Application	

Week 23	**Part – 4 Robotics** **Chapter 21** Robotics Introduction	● Robotics Introduction
		    ○ Robotics Industry use cases
		    ○ Robotics Tools Introduction and installation	

Week 24	**Chapter 22** Arduino Programming	● Arduino Input and Output ● Libraries in Arduino IDE ● Data reading using sensors	
Week 25	**Chapter 23** Raspberry Pi	● Raspberry Pi Introduction ● Configuration ● Deep Learning project	
Week 26	Entrepreneurship and Final Assessment in project	● Job Market Searching ● Self-employment ● Freelancing sites ● Final Assessment	

List of Machinery / Equipment

Sr. No	Name of item as per curriculum	Quantity physically available at the training location
1	Computers Minimum Corei5 ● LCD Display 17" with built in speakers	25
3	DSL Internet Connection (Minimum 1 MB)	Available on every PC
4	**Accessories/Devices** ● Connectors ● Multimedia ● Printer (NW printer) ● Audio/visual aid ● White Board ● Pin Board ● Flip Chart Board	25 each

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051-9044250

	• Hard copy of Training Material • Web Cameras	
5	Wires, data cables, power plugs, power supply	For every PC
6	**UPS**	Available
7	**Generator / Solar Backup**	Available
8	**Air Conditioner (2 Tons)**	Available

1. **Software List**

Sr. No	Software Name
1.	MS Office 2016 (Installed on each PC)
2.	Operating System (Windows, Linux or other Operating Systems)
3.	Programming Languages including python (Ananconda, Jupyter, Spider, Pycharm)
4.	Weka, Rapid Miner, Orange
5.	Web browser including Internet Explorer, Google Chrome, Mozilla Firefox, Netscape, Opera (installed on each PC)
6.	Firewall (each PC)

2. **Minimum Qualification of Teachers / Instructor**

The qualification of teachers / instructor of this course should be minimum **of bachelors in Computer science with minimum 3 years of development experience** in relevant trade.
- Bachelors of Computers Science / Computer Engineering / Electrical Engineering (Hons)

Plot no. 38, Kirthar Road, H-9 Islamabad
051-9044250

3. Supportive Notes

Teaching Learning Material

Books Name	Author
Artificial Intelligence – A Modern Approach (3rd Edition)	Stuart Russell and Peter Norvig
Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition	
Digital Image Processing – 3rd Edition	Rafeal C. Golzenaz
Deep Learning: A Practitioner's Approach	Adam Gibson and Josh Patterson
Deep Learning	Aaron Courville, Ian Goodfellow, and Yoshua Bengio
Deep Learning with Python	Francois Chollet

Online Material:

FukatSoft Online Learning System

Stanford Lectures on Deep Learning

Machine Learning by Andrew Ng