Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"

Course Contents / Lesson Plan

Course Title: Artificial Intelligence (Robotics)

Duration: 06 Months

Course Details / Description & Preliminaries

Course Title	Artificial Intelligence (Robotics)
Objectives and Expectations	**Employable skills for Bachelor of Computer Science (BCS) / B.Sc (Computer Science) through an intensive course on Artificial Intelligence(Robotics)** This is a special course designed to address unemployment in the youth. The course aims to achieve the above objective through hands on practical training delivery by a team of dedicated professionals having rich market/work experience. This course is therefore not just for developing a theoretical understanding/back ground of the trainees. Contrary to that it is primarily aimed at equipping the trainees to perform commercially in a market space in independent capacity or as a member of a team. The course therefore is designed to impart not only technical skills but also soft skills (i.e. interpersonal/communication skills; personal grooming of the trainees etc) as well as entrepreneurial skills (i.e. marketing skills; free lancing etc). The course also seeks to inculcate work ethics to foster better citizenship in general and improve the image of Pakistani work force in particular. **Main Expectations**: In short, the course under reference should be delivered by professional instructors in such a robust hands-on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion. This course thus clearly goes beyond the domain of the traditional training practices in vogue and underscores an expectation that a market centric approach will be adopted as the main driving force while delivering it. The

	instructors should therefore be experienced enough to be able to identify the training needs for the possible market roles available out there. Moreover, they should also know the strengths and weaknesses of each individual trainee to prepare them for such market roles during/after the training.
Key Features of Training& Special Modules	**I.** Specially designed practical tasks to be performed by the trainees have been included in the Annexure-I to this document. The record of all tasks performed individually or in groups must be preserved by the management of the training Institute clearly labelling name, trade, session etc so that these are ready to be physically inspected/verified through monitoring visits from time to time. The weekly distribution of tasks has also been indicated in the weekly lesson plan given in this document. **II.** In order to materialize the main expectations, a special module on **Job Search & Entrepreneurial Skills** has been included in the later part of this course (5th & 6th month) through which, the trainees will be made aware of the Job search techniques in the local as well as international job markets (Gulf countries). Awareness around the visa process and immigration laws of the most favoured labour destination countries also forms a part of this module. Moreover, the trainees would also be encouraged to venture into self-employment and exposed to the main requirements in this regard. It is also expected that a sense of civic duties/roles and responsibilities will also be inculcated in the trainees to make them responsible citizens of the country. **III.** A module on **Work Place Ethics** has also been included to highlight the importance of good and positive behaviour at work place in the line with the best practices elsewhere in the world. An outline of such qualities has been given in the Appendix to this document. Its importance should be conveyed in a format that is attractive and interesting for the trainees such as through PPT slides +short video documentaries. Needless to say that if the training provider puts his

	heart and soul into these otherwise non-technical components, the image of Pakistani workforce would undergo a positive transformation in the local as well as international job markets. In order to maintain interest and motivation of the trainees throughout the course, modern techniques such as: • Motivational Lectures • Success Stories • Case Studies These techniques would be employed as an additional training tool wherever possible (these are explained in the subsequent section on Training Methodology). Lastly, evaluation of the competencies acquired by the trainees will be done objectively at various stages of the training and proper record of the same will be maintained. Suffice to say that for such evaluations, practical tasks would be designed by the training providers to gauge the problem solving abilities of the trainees
Training Tools/ Methodology	**(i) Motivational Lecture** The proposed methodology for the training under reference employs motivation as a tool. Hence besides the purely technical content, a trainer is required to include elements of motivation in his/her lecture. To inspire the trainees to utilize the training opportunity to the full and strive towards professional excellence. Motivational lectures may also include general topics such as the importance of moral values and civic role & responsibilities as a Pakistani. A motivational lecture should be delivered with enough zeal to produce a deep impact on the trainees. It may comprise of the following: Clear Purpose to convey message to trainees effectively.

	Personal Story to quote as an example to follow. Trainees Fit so that the situation is actionable by trainees and not represent a just idealism. Ending Points to persuade the trainees on changing themselves. A good motivational lecture should help drive creativity, curiosity and spark the desire needed for trainees to want to learn more. Impact of a successful motivational strategy is amongst others commonly visible in increased class participation ratios. It increases the trainees' willingness to be engaged on the practical tasks for longer time without boredom and loss of interest because they can clearly see in their mind's eye where their hard work would take them in short (1-3 years); medium (3 - 10 years) and long term (more than 10 years). As this tool is expected that the training providers would make arrangements for regular well planned motivational lectures as part of a coordinated strategy interspersed throughout the training period as suggested in the weekly lesson plans in this document. **(ii) Success Stories** Another effective way of motivating the trainees is by means of Success Stories. Its inclusion in the weekly lesson plan at regular intervals has been recommended till the end of the training. A success story may be disseminated orally, through a presentation or by means of a video/documentary of someone that has risen to fortune, acclaim, or brilliant achievement. A success story shows how a person achieved his goal through hard work, dedication and devotion. An inspiring success story contains compelling and significant facts articulated clearly and easily comprehendible words. Moreover, it is helpful if it is assumed that the reader/listener knows nothing of what is being revealed. Optimum impact is created when the story is revealed in the form of:-

	● Directly in person (At least 2-3 cases must be arranged by the training institute) ● Through an audio/ videotaped message (2-3 high quality videos must be arranged by the training institute) It is expected that the training provider would collect relevant high quality success stories for inclusion in the training as suggested in the weekly lesson plan given in this document. Suggestive structure and sequence of a sample success story and its various shapes can be seen at annexure III. **(iii) Case Studies** Where a situation allows, case studies can also be presented to the trainees to widen their understanding of the real life specific problem/situation and to explore the solutions. In simple terms, the case study method of teaching uses a real life case example/a typical case to demonstrate a phenomenon in action and explain theoretical as well as practical aspects of the knowledge related to the same. It is an effective way to help the trainees comprehend in depth both the theoretical and practical aspects of the complex phenomenon in depth with ease. Case teaching can also stimulate the trainees to participate in discussions and thereby boost their confidence. It also makes class room atmosphere interesting thus maintaining the trainee interest in training till the end of the course. Depending on suitability to the trade, the weekly lesson plan in this document may suggest case studies to be presented to the trainees. The trainer may adopt a power point presentation or video format for such case studies whichever is deemed suitable but it's important that only those cases are selected that are relevant and of a learning value. The Trainees should be required and supervised to carefully analyse the

	cases. For the purpose they must be encouraged to inquire and collect specific information / data, actively participate in the discussions and intended solutions of the problem / situation. Case studies can be implemented in the following ways:- **i.** A good quality trade specific documentary (At least 2-3 documentaries must be arranged by the training institute) **ii.** Health & Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute) **iii.** Field visits (At least one visit to a trade specific major industry/ site must be arranged by the training institute)
Learning Outcome of the Course	After completion of this course, the trainees must be able to: ● Design/Development of solutions for different Industrial applications ● Understanding of modern tool usage (AI & Robotics) in Industry 4.0 ● An ability to work effectively, as an individual and in a team ● To start own business and develop pragmatic industrial solutions. ● Able to Understand and implement Robotics and AI ● Able to design, 3D print and implement an AI based robot to solve a problem ● Able to develop and Implement AI based Industrial Robotics applications.
Entry level of trainees	Since intake level is Bachelor of Computer Science (BCS) / B.Sc (Computer Science) through an intensive course on Artificial Intelligence(Robotics), so expectations from the trainees are: ● Have knowledge of Programming Concepts ● Have studied languages such as C, C++, Python ● Have concept of Computer system ● Having a knowledge of Basic electronics ● Having a hands on experience on CAD Software's

● Course Execution Plan	● Total Duration of Course: 6 Months (26 Weeks)
	● Class Hours: 5 Hours per day (05 Days/Week)
	● Theory: 20% Practical: 80%
	● Weekly Hours: 25 Hours Per week
	● Total Contact Hours: 600 Hours
Companies Offering Jobs in the respective trade	Besides overseas employment, the following Pakistani companies/firms/Organizations are also offering jobs as well, with details as under. ● Freelancing (Fiverr, Upwork, Freelancers) ● Textile Industry ● Cement Industry ● Software Houses ● Telecommunication Companies ● Automotive Industry ● Product Quality Investigation Industries
Job Opportunities	The participants may be able to: ● Automotive Industries ● Product quality investigation in Industries ● Textile Industry, Cement Industry ● Law enforcement agency ● Health care centre ● Medical diagnostic ● Entertainment Industry ● Mobile application development ● Telecommunication companies ● Software Houses
No of Students	● 25
Learning Place	● Classroom / Lab

WEEKLY SCHEDULE OF TRAINING

Scheduled Week	Module Title	Learning Units	Remarks
Week 1	**Introduction**	• Course Introduction • **Motivational Lecture** (For further detail please see Page No: 4-5) • Applications of the course • Job market overview • Fundamentals of Robotics. • How to read off digital and analog signals for Robot Control • Getting Familiar with basic sensors used in Robotics • Arduino based DC motor control of Robots • Implementation of Line Sensors (IR and RGB) based Autonomous Robot • Basic knowledge of CAD • **Institute/Work ethics** (For further detail please see Annexure-II at the end)	**Task No.1** (Details may be seen in Annexure I) **Home Assignment No. 1** (Details may be seen in Annexure V)
Week 2	**Control**	• Implementation of Obstacle Avoidance Algorithm on Autonomous Robots • Implementation of Fire Sensors based Autonomous Robots • RC Control of Robots • **Success story** (For further detail please see Page No: 5-6and Annexure-III at the end)	**Task No.2** (Details may be seen in Annexure I) **Home Assignment No.2** (Details may be seen in Annexure V)
Week 3	**Introduction to CAD Modeling**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • CAD Modeling • Introduction to Solid Works • Installation • Basic functions	**Task No. 3 & 4** (Details may be seen in Annexure I) **Home Assignment No. 3** (Details may be seen in

			Annexure V)
Week 4	**2D Modeling**	• 2D modeling • Introduction to 2D tools • 2D Sketching techniques • Practice 2D Modeling • **Institute/Work ethics** (For further detail please see Annexure-II at the end) • **Case Study** (Health & Safety) (For further detail please see Page No: 6-7)	**Task No. 5** (Details may be seen in Annexure I) **1st Monthly Test**
Week 5	**3D Modeling**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • 3D Modeling • Introduction to 3D tools • 3D Sketching techniques • Practice 3D Modeling • **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end)	**Task No. 6 & 7** (Details may be seen in Annexure I) **Home Assignment No. 4 & 5** (Details may be seen in Annexure V)
Week 6	**Introduction to Additive manufacturing**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • Introduction to Additive Manufacturing • Additive manufacturing techniques • **Institute/Work ethics** (For further detail please see Annexure-II at the end)	**Task No. 8** (Details may be seen in Annexure I) **Home Assignment No. 6** (Details may be seen in Annexure V)
Week 7	**3D Printing**	• 3D printing • Introduction to CURA software • Extraction of GM codes • **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end)	**Task No. 9** (Details may be seen in Annexure I) **Home Assignment No. 7**

			(Details may be seen in Annexure V)
Week 8	**Use of 3D Printer**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • Demonstration of 3D printer • Calibration • Setup • **Case Study** (Health & Safety)(For further detail please see Page No: 6-7)	**Task No. 10** (Details may be seen in Annexure I) **2nd Monthly Test**
Week 9	**Printing Practice**	• Printing of Robots Structure • **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end)	**Task No. 11** (Details may be seen in Annexure I)
Week 10	**Arduino**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • Arduino Input Output Signals • Libraries in Arduino IDE • Data reading using Sensors • Libraries in Arduino IDE • Generation of PWM Signals for Motor Driving Circuits • Libraries in Arduino IDE	**Task No. 12** (Details may be seen in Annexure I)
Week 11	**Interfacing of Sensors with Arduino**	• Application of Line Sensors • Libraries in Arduino IDE • Application of Ultrasonic Sensors • Libraries in Arduino IDE • Application of Fire Sensor • Libraries in Arduino IDE • **Case Study**(For further detail please see Page No: 6-7)	**Task No. 13** (Details may be seen in Annexure I)
Week 12	**Drive Motors**	• Motor Driver Circuits	**Task No. 14** (Details may be

	using Arduino	• Speed Control of Motor • Application of DC motor • Application of Servo Motor • Application of Stepper Motor • Controlling angle of stepper motor	seen in Annexure I)
Week 13	**Use Arduino for Robotics**	• **Motivational Lecture**(For further detail please see Page No: 4-5) • Application of Robot Controller • Libraries in Arduino IDE • Programming , Circuit Fabrication, Assembling and Troubleshooting of Line Following/Obstacle Avoidance/Fire Fighting Robot • Tips for how to increase earning	**Task No. 15 & 16** (Details may be seen in Annexure I)
Week 14	**Overview of the Previous Weeks & Mid Term Examination**		
Week 15	**Machine Learning** **Freelancing**	• Overview of Mid-Term Examination • Machine Learning • Introduction to Freelancing • **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end)	**Task No.17** (Details may be seen in Annexure I)
Week 16	**Machine Learning**	• **Motivational Lecture** (For further detail please see Page No: 4-5) • Supervised and unsupervised learning • Scikit-learn	**Task No. 18** (Details may be seen in Annexure I)
Week 17	**Machine Learning** **Freelancing**	• Supervised and unsupervised learning • Scikit-learn • Freelancing concepts, how to start, step by step process from account opening to taking orders and contract signing etc. • Freelancing platforms • **Institute/Work ethics** (For further detail please see Annexure-II at the end)	**Task No. 19** (Details may be seen in Annexure I) **4th Monthly Test**
Week 18	**Machine**	• Machine Learning and Artificial Intelligence	**Task No. 20**

	Learning **Freelancing** **Job Search & Entrepreneurial Skills**(Job Search)	● Libraries in python ● Freelancing continued…. **Job market & job search** ● Job related skills. ● Interpersonal skills ● Communication skills ● **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end)	(Details may be seen in Annexure I)
Week 19	**Machine Learning** **Job Search & Entrepreneurial Skills**(CV Building)	● **Motivational Lecture** (For further detail please see Page No: 4-5) ● Machine Learning and Artificial Intelligence ● Libraries in python **Session on CV Building.** ● How to make notable CV. ● Dos and Don'ts of CV making. ● **Institute/Work ethics** (For further detail please see Annexure-II at the end	**Task No.21** ((Details may be seen in Annexure I)
Week 20	**Machine Learning** **Freelancing**	● Data Science and Data Visualization ● Libraries in python ● Freelancing (Get some small projects of General Topics) ● Tips for how to increase earning ● **Case Study**(For further detail please see Page No: 6-7)	**Task No. 22** (Details may be seen in Annexure I)

Week 21	**Machine Learning** **Job Search/ Entrepreneurial skills**(self-business)	● **Motivational Lecture**(For further detail please see Page No: 4-5) ● Data Science and Data Visualization ● Libraries in python **Session on Self Employment** ● How to start a Business ● Requirements (Capital, Physical & Human Resources etc) ● Benefits/Advantages of self-employment	**Task No. 23, 24 & 25** (Details may be seen in Annexure I) **5th Monthly Test**
Week 22	**Robot Simulation Software** **Job search/ Entrepreneurial skills**(General Overseas Employment)	● **Motivational Lecture** (For further detail please see Page No: 4-5) ● Robot Simulation **Session on General Overseas Employment opportunities.** ● Job search Avenues. ● Visa Processes and other necessary requirements. ● Immigration Information (Legal age requirements, Health Certificate, Police Clearance &Travel Insurance.	**Task No. 26** (Details may be seen in Annexure I)
Week 23	**Project Selection and Proposal** **Job search/ Entrepreneurial skills** (one country case)	● Projects (Design & Manufacture Robot + Computer Vision + Image Processing) ● Project Presentation ● **Success story** (For further detail please see Page No: 5-6 and Annexure-III at the end) ● **Selection of a country of destination (Gulf Countries, Malaysia, South Korea etc.) focusing on** ● Trade specific Job Prospects and Earning levels. ● Country Specific Labor laws, entry and exit requirements (Legal age requirements, Health Certificate, Police Clearance & Travel Insurance etc.).	**Task No. 27** (Details may be seen in Annexure I)

Week 23	**Report Writing**	● **Motivational Lecture** (For further detail please see Page No: 4-5) ● Report Writing Techniques	**Task No. 28** (Details may be seen in Annexure I)
Week-24	**Final Project**	● **Motivational Lecture** (For further detail please see Page No: 4-5) ● 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 trainees 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 3 weeks ● The project will be presented in front of Industrialists for commercialization ● The best business idea will be placed in NAVTTC business incubation center for commercialization.	
Week 25	**Job Search/ Entrepreneurial skills**(Two countries)	**Selection of another country of destination (Gulf Countries, Malaysia, South Korea etc) focusing on:-** I. Trade specific Job Prospects and Earning levels in that country. II. Country Specific Labor laws, entry and exit requirements (Legal age requirements, Health Certificate, Police Clearance & Travel Insurance etc.).	
Week 26		● **Project Finalization (Completion) Display** ● **Final Assessment**	**Final Assessment**

Annexure-I

Tasks for Development of Robotics & Artificial Intelligence

Note: The following tasks are required to be performed multiple times by each trainee/group until sufficient proficiency level is acquired. The trainer is required to determine the number of times the task needs to be repeated by a trainee as per his/her low/medium/high level of skill and proficiency during any stage of the course.

Task No.	Task	Description	Week No
1.	**Fundamentals of Robotics**	● Implementation of Line Sensors	**Week-1**
2.	**Control system of Robots**	● Implementation of Obstacle Avoidance Algorithm ● Implementation of Fire Sensors based	**Week-2**

		Autonomous Robots	
3.	**Introduction to CAD Modelling**	**Trainees will install Solid Works in their laptops** ● Computer Aided Designing Provides a hands-on introduction to the use of computer aided design (CAD) for mechanical engineering design processes. It employs the Solid Works (SW) software for creating solid models, dimensioned mechanical drawings, and rapid prototype output (3D printing). ● Computer Aided Manufacturing Explore the design for manufactures workflow and shows how to validate models and create the G code, the programming language needed to instruct the CNC machine/3D printer on how to move. We practice the basics of part and assembly design, and tools such as animation using Solid works. They will be able to: - Explain the design to manufacturing process used to take a digital model to a physical part through CNC programming. And demonstrate knowledge and skills in Solid works applying design and manufacturing workflows to take digital parts to physical prototypes.	**Week-3**
4.	**2D Modelling**	**Regenerate 2D sketches** ● 2D sketching covers the methods and commands to create sketches used in the Part environment. In Solid Works, they can learn, How to create sketches in the Sketch environment. ● Sketching Commands in Solid Works provides sets of commands to create different sketches.	
5.	**2D Modelling Practice**	**Practice 30 different 2D Sketches** ● Students will practice recreating 30 different 2D sketches from the provided manual.	**Week-4**
6.	**3D Modelling**	**Convert 2D sketched to 3D** ● Three-dimensional (3D) models represent a physical body using a collection of points in 3D space, connected by various geometric entities such as triangles, lines, curved surfaces, etc. Being a collection of data (points and other information),	**Week-5**

		3D models can be created manually, algorithmically (procedural modelling), or by scanning. ● Different 3D Modelling Techniques are used (Extrude, Revolve, Plane command ,Project, Extrudedcuts, Revolvecuts, Ribs, Sweep, Blend command) to create three Dimensional model ● Assembly of 3D parts. ● After creating individual components, They can bring them together into an assembly. By doing so, it is possible to identify incorrect design problems that may not have been noticeable at the part level. In this topic, they will learn how to bring components into the Assembly environment and position them.	
7.	**3D Modelling Practice**	**Practice converting 30 2D sketches into 3D Model** ● 3D Modelling from 30 different 2D sketches from the provided manual.	
8.	**Introduction to Additive Manufacturing**	**Installing CURA software** Students will get familiar to: ● Different manufacturing techniques ● Additive manufacturing Additive Manufacturing or 3D printing as it's also known. To explore the basics of geometry creation and the mindset shift needed to build a generative design—a deeper understanding of generative design, its parameters, and how to work with the results specifically aimed at making a 3D printed part. To develop insightful understanding of the generative workflow by exploring software's tools and combining them with the creative process of taking an idea to a 3D model. We'll learn how to focus on where a design is and isn't and apply the generative design thinking process to define a study as we take a deeper dive into Solid Works, CURA. ● Software and hardware used in manufacturing	**Week-6**
9.	**Introduction to 3D Printing**	**Practice GM Codes extraction** Students will get familiar to: ● Basics of 3D Printing ● Hardware (3D printer) and Software (CURA) for 3D Printing	**Week-7**

		● GM Codes	
10.	**Use of 3D printing**	**Create 3D model and extract GM codes using CURA software** Students will understand the use of: ● 3D Printer ● CURA Software Students will get trained to: ● Setup 3D printer ● Install 3D printer ● Add Filament to the 3D printer ● Calibrate 3D printer ● Extract GM codes from 3D model and feed it into 3D printer	**Week-8**
11.	**Printing Practice + Project**	**Create 3D model, extract code and 3D Print** ● Students will practice 3D printing 3 different models using 3D printer. ● Students will complete a project: Students will create conceptual design, create its 2D and convert it into 3D model. Further, they will extract GM codes from the 3D model and 3D print it using 3D printer.	**Week-9**
12.	**Arduino Input Output Signals Libraries in Arduino IDE**	**1. (Trigger a digital output by means of a digital input)** **2. Data reading using Sensors** **3. Libraries in Arduino IDE** **4. (Trigger an output pin using sensor input)** **5. Generation of PWM Signals for Motor Driving Circuits** **6. Libraries in Arduino IDE** **7. (Change direction of a DC motor using Hbrigde)** ● How to read off digital and analog signals for Robot Control ● Getting Familiar with basic sensors used in Robotics ● Arduino based DC motor control of Robots	**Week-10**
13.	**Application of Line Sensors Libraries in Arduino IDE**	**1. Trigger various three separate output pins of arduino using three different colors)** **2. Application of Ultrasonic Sensors** **3. Libraries in Arduino IDE** **4. (Change direction of robot using ultrasonic input signal)** ● Implementation of Line Sensors (IR and RGB) based Autonomous Robot ● Implementation of Obstacle Avoidance Algorithm on Autonomous Robots	**Week-11**

14.	**Application of motors with Arduino.**	• **Control DC motor using Arduino** • Interface Motor driver circuit with Arduino. • Change speed of dc motor. • Change direction of rotation. • **Control Stepper Motor using Arduino** • Understanding of different pins of stepper motor. • Control angle of stepper motor using Arduino. • **Control Servo motor using Arduino** • Understanding of different pins of servo motor. • Control angle of servo motor using Arduino.	
15.	**Application of Fire Sensor Libraries in Arduino IDE**	**Trigger output pins of arduino for alarm and water pump using input from fire sensor)** ● Implementation of Fire Sensors based Autonomous Robots	**Week-12**
16.	**Application of Robot Controller**	**1. Libraries in Arduino IDE** **2. Change direction of your robot using RC mobile app** **3. Programming, Circuit Fabrication , Assembling and Troubleshooting of Line Following/Obstacle Avoidance/Fire Fighting Robot** ● RC Control of Robots ● Robotics Competition between Batch Students	
17.	**Machine Learning**	**Theory and Mathematical concepts of Machine learning** ● Aspects of developing a learning system: training data, concept representation, function approximation	**Week–14**
18.	**Machine Learning**	**Applying Algebraic and statistical methods in machine learning algorithms. Concept of vector, array, matrix, sigmoid, softmax, local minima , local maxima, entropy etc.** ● The concept learning task. ● Concept learning as search through a hypothesis space. ● General-to-specific ordering of hypotheses. ● Finding maximally specific hypotheses. ● Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. ● The importance of inductive bias.	**Week–15**

19.	**Supervised, unsupervised and Reinforcement learning**	**1. Removing noisy data.** **2. Data labelling for supervised learning.** **3. Implementation of supervised and unsupervised learning.** ● Types of Machine learning. ● Difference between Supervised, unsupervised and Reinforcement learning. ● Different types of algorithms in Supervised, unsupervised and Reinforcement learning approaches. ● Handling data for different machine learning approaches.	**Week-16**
20.	**Data science using Machine learning approaches in Python**	**1. Dimension reduction (SVD, PCA). Installing various machine learning python libraries for data science task.** **2. Applying classification, regression and clustering algorithms for data science tasks.** ● Libraries and approaches used for data science tasks. ● Classification, regression and clustering. ● Pre-processing and dimension reduction.	**Week-17**
20	**Image processing for Machine Learning Algorithms in python**	**1. Installing various image processing python libraries for image processing tasks.** **2. Applying various image processing functions over images to extract different features of images.** **3. Image conversion, Edges detection, image enhancement, Histogram equalizations etc.** ● Industries usage of image processing. ● Libraries and image processing approaches used for machine learning tasks.	**Week-18**
21	**Computer Vision and Machine Learning using python**	**1. Installing various image processing python libraries for computer vision tasks.** **2. Implementing supervised and unsupervised machine learning algorithms to accomplish various computer vision tasks** ● Industries usage of computer vision. ● Libraries and computer vision approaches used for machine learning tasks.	**Week-19**
22.	**Natural Language processing and Machine Learning using python.**	**1. Installing python libraries NLP.** **2. Implanting various operations on text data to make it useful for NLP task.** **3. Sentiment analysis, chatbot creation** ● Industries usage of Natural language processing. ● Libraries and NLP approaches used for machine leaning and non-machine learning	**Week-20**

		tasks.	
22 a.	**Create an account profile on Fiverr (at least two gigs) and Upwork**	Create an account by following these steps: **Step 1:** Personal Info **Step 2:** Professional Info **Step 3:** Linked Accounts **Step 4:** Account Security **Step 5**: Sort out top freelancers and study their profile. **Step 6**: Update your profile following the style of shortlisted profiles. **4.**	
23.	**Model evaluation and Data Visualization**	**Using different Libraries in python for data visualization** ● How to evaluate a model? ● Parameters for evaluating machine learning and non-machine approaches. ● Different Libraries for visualizing results.	
24.	**Model evaluation and Data Visualization**	**Using different Libraries in python for data visualization** ● Visualize the results of the algorithms ● Understanding the visualized results.	
25.	**Robot Simulation**	**1. Make 1 table for different joint angle configuration (six pose only).** **2. Make 1 table for different joint angle configuration (six pose only).** **3. Make 1 table for different joint angle configuration (six pose only).** ● inverse kinematics of serpent robot ● inverse kinematics of gryphonec ● joint configuration at ready, stretch, nominal and zero poles	**Week-21**
26.	**Project**	● Design & Manufacture Robot + Computer Vision + Image Processing	**Week-22**
27.	**Report Writing**	● Report writing techniques	**Week-23**

Annexure-II

Workplace/Institute Ethics Guide

Work ethic is a standard of conduct and values for job performance. The modern definition of what constitutes good work ethics often varies. Different businesses have different expectations. Work ethic is a belief that hard work and diligence have a moral benefit and an inherent ability, virtue or value to strengthen character and individual abilities. It is a set of values centred on importance of work and manifested by determination or desire to work hard.

The following ten work ethic are defined as essential for student success:

1. **Attendance:**
   Be at work every day possible, plan your absences don't abuse leave time. Be punctual every day.
2. **Character:**
   Honesty is the single most important factor having a direct bearing on the final success of an individual, corporation, or product. Complete assigned tasks correctly and promptly. Look to improve your skills.
3. **Team Work:**
   The ability to get along with others including those you don't necessarily like. The ability to carry your own weight and help others who are struggling. Recognize when to speak up with an ideas and when to compromise by blend ideas together.
4. **Appearance:**
   Dress for success, set your best foot forward, personal hygiene, good manner, remember that the first impression of who you are can last a life time
5. **Attitude:**
   Listen to suggestions and be positive, accept responsibility. If you make a mistake, admit it. Values workplace safety rules and precautions for personal and co-worker safety. Avoids unnecessary risks. Willing to learn new processes, systems and procedures in light of changing responsibilities.
6. **Productivity:**
   Do the work correctly, quality and timelines are prized. Get along with fellows, cooperation is the

key to productivity. Help out whenever asked, do extra without being asked. Take pride in yourwork, do things the best you know how. Eagerly focuses energy on accomplishing tasks, also referred to as demonstrating ownership. Takes pride in work.

7. **Organizational Skills:**

   Make an effort to improve, learn ways to better yourself. Time management, utilize time and resources to get the most out of both. Takes an appropriate approach to social interactions at work. Maintains focus on work responsibilities.

8. **Communication:**

   Written communication, being able to correctly write reports and memos. **Verbal communications,** being able to communicate one on one or to a group.

9. **Cooperation:**

   Follow institute rules and regulations, learn and follow expectations. Get along with fellows, cooperation is the key to productivity. Able to welcome and adapt to changing workplace situations and the application of new or different skills.

10. **Respect:**

    Work hard, work to best of your ability. Carry out orders, do what's asked the first time. Show respect, accept and acknowledge an individual's talents and knowledge. Respects diversity in the workplace, including showing due respect for different perspectives, opinions and suggestions.

Annexure-III

Suggestive Format and Sequence Order of Success Story

S. No	Key Information	Detail/Description
1.	**Self & Family background**	● Self-introduction ● Family background and socio economic status, ● Education level and activities involved in ● Financial hardships etc
2.	**How he came on board NAVTTC Training/ or got trained through any other source**	● Information about course, apply and selection ● Course duration, trade selection ● Attendance, active participation, monthly tests, interest in lab work
3.	**Post training activities**	● How job / business (self-employment) was set up ● How capital was managed (loan (if any) etc). ● Detail of work to share i.e. where is job or business being done; how many people employed (in case of self-employment/ business) ● Monthly income or earnings and support to family ● Earning a happy life than before
4.	**Message to others** **(under training)**	● Take the training opportunity seriously ● Impose self-discipline and ensure regularity ● Make Hard work pays in the end so be always ready for the same.

Note: Success story is a source of motivation for the trainees and can be presented in a number of ways/forms in a NAVTTC skill development course as under:-

1. To call a passed out successful person of institute. He/she will narrate his/her success story to the trainees in his/her own words and meet trainees as well.
2. To see and listen to a recorded video/clip (5 to 7 minutes) showing a successful person Audio video recording that has to cover the above mentioned points.
3. The teacher displays the picture of a successful trainee (name, trade, institute, organization, job, earning per month etc) and narrates his/her story in teacher's own motivational words.

Annexure-IV

Home Assignment

Designing Effective Homework

To achieve a positive impact on student learning, homework assignments must be well-designed and carefully constructed. Some specific research findings include:

- Homework is most effective when it covers material already taught.
- Homework is most effective when it is used to reinforce skills learned in previous weeks or months.
- Homework is less effective if it is used to teach complex skills.

Characteristics of Good Assignments

When teachers plan homework, they should consider the characteristics listed below:

- Provide clear instructions for students;
- Can be completed successfully;
- Are not too long;
- Can be completed within a flexible time frame;
- Use information and materials that are readily available;
- Reinforce and allow practice of previously taught skills;
- Must not be unfinished class work;
- Are interesting to students and lead to further exploration and study;
- Stimulate creativity and imagination in the application of skills;
- Stimulate home and class discussion

Homework Don'ts

Do not assign homework that:

- is unfamiliar, boring or impossible to do
- requires complex skills or requires unreasonable time frames
- is a "time filler" to keep students busy or a punishment for not doing class work
- do not wait until the last minute to organize and assign the homework (You may give useless or impossible tasks and/or giving inadequate directions)
- do not assume that all homes have equal resources, that all parents have equal skills and talents to support their children as learners
- do not collect any homework you do not intend to check, review or grade.
- do not assign homework that is so difficult and unfamiliar to students that their parents are tempted to:
    - do the work for them;
    - accuse their children of being inattentive in class; or
    - accuse their children of failing.

Annexure-V

Home Assignments during Training

S. No.	Description	Week No.
1	Discussion on the latest research papers based on different Robotics applications	Week-1
2	Study of Robotic kinematic and different algorithm for detection and avoidance of object by the autonomous robots	Week-2
3	Install Solid Works in their own laptops	Week-3
4	Convert given 2D sketches into 3D models	Week-5
5	Create 3D models from the given 2D	
6	Write short note on different additive manufacturing techniques	Week-6
7	Practice using CURA software and extract GM code of already created 3D models	Week-7

References

1. A Union of Professionals, Classroom Tips, Assigning Effective Homework https://files.eric.ed.gov/fulltext/ED516934.pdf visited on 7th June, 2020