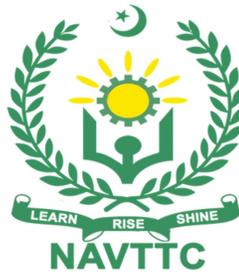


Government of Pakistan

National Vocational and Technical Training Commission

Prime Minister's Hunarmand Pakistan Program

"Skills for All"



Course Contents/ Lesson Plan

Course Title: Advance Embedded Systems

Duration: 6 Months

Revised Edition

Trainer Name	
Course Title	Advance Embedded Systems
Objectives and Expectations	<p>Employable skills and hands on practice for different microcontrollers.</p> <p>Course provides an opportunity to build a great career in the field of Embedded system design, course start from basic level and then move towards the advance level. Starting from introduction of Embedded system then move towards design of operating system in embedded system. This course will cover the different microcontroller's architecture likewise AVR, ARM Cortex M and ARM Cortex A.</p> <p><u>Main Expectations:</u></p> <p>In short, the course under reference should be delivered by professional instructors in such robust hands- on manner that the trainees are comfortably able to employ their skills for earning money (through wage/self-employment) at its conclusion, where's hands on practice are not valid than demonstration will be required through video contents/ project prototype.</p> <p>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.</p> <ol style="list-style-type: none">1. 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 labeling 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.2. A module on Workplace Ethics has also been included to highlight the importance of good and positive behavior 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.

1. Motivational Lectures

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:

1. Clear Purpose to convey message to trainees effectively.
2. Personal Story to quote as an example to follow.
3. Trainees Fit so that the situation is actionable by trainees and not represent a just idealism.
4. 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.

5. 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 comprehensible 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:-

1. Directly in person (At least 2-3 cases must be arranged by the training institute)
2. 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.

3. 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

	<p>explore the solutions.</p> <p>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 classroom atmosphere interesting thus maintaining the trainee interest in training till the end of the course.</p> <p>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.</p> <p>The Trainees should be required and supervised to carefully analyze the cases.</p> <p>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.</p> <p>Case studies can be implemented in the following ways: -</p> <ol style="list-style-type: none"> 1. A good quality trade specific documentary (At least 2-3 documentaries must be arranged by the training institute) 2. Health & Safety case studies (2 cases regarding safety and industrial accidents must be arranged by the training institute) <p>Field visits (At least one visit to a trade specific major industry/ site must be arranged by the training institute)</p>
<p>Entry level of trainees</p>	<p>Since intake level is Bachelor of Computer Science (BCS) / B.E (Electrical Engineering) so expectations of the trainees are:</p> <ul style="list-style-type: none"> • Have knowledge of Programming Concepts • Have knowledge of hardware concepts • Have studied languages such as C or C++. • Have concept of Computer system
<p>Learning Outcomes of the</p>	<p>After completion of this course, the trainees must be able to do:</p>

<p>course</p>	<p>System Designing</p> <ul style="list-style-type: none"> • Planning, coding and designing alternative solutions in the field. • Finding problems with hardware, robust, power and even cost effective embedded system. • Understand key concepts and components that make embedded system. • Enabling key technologies and protocols that enable embedded system. • Working on different devices such as AVR ATmega328, ARM Cortex M STM32Fx, ARM Cortex A and sensory data acquisition with RTOS to make a complete embedded system. • Select components like micro controller, actuator and sensors for designing of a system. <p>Entrepreneurship</p> <ul style="list-style-type: none"> • Analyze customer demand • Perform cost analysis of customer demand • Conduct market survey for project estimation • Prepare quotation for customer • Negotiate with customer • Deal with customer and signed MOU • Prepare quotations/ invoice report • Complete the Work done on site <p>Soft skills /Teamwork/professionalism</p> <ul style="list-style-type: none"> • Develop professionalism • Motivational Lectures • Success Stories • Develop work ethics • Follow teamwork environments principals • Ensure punctuality of time • Ensure job deliverable within assigned time frame • Show dedication and commitment with your duty • Be creative in your work • Ensure positive attitude in group task • Ensure willing worker attitude in teamwork • Be goal oriented
----------------------	--

	<ul style="list-style-type: none"> • Ensure HSE SOPs • Obey organizational rules and regulations • Be loyal with your duty and organization • Honesty is best policy
Course Execution Plan	<p>Total duration of course:6 months (26 Weeks)</p> <p>Class hours:4 hours per day</p> <p>Theory:20%</p> <p>Practical: 80%</p> <p>Weekly hours: 20 hours per week</p> <p>Total contact hours: 520hours</p>
Companies offering jobs in the respective trade	<ol style="list-style-type: none"> 1. Industrial Sector 2. Offices 3. Automotive 4. Home Appliance 5. Medical Equipment 6. Wearables 7. Telecom
Job Opportunities/job titles	<ul style="list-style-type: none"> • Embedded Developer • Embedded Engineer • Automation Engineer
No of Students	25
Learning Place	Classroom / Lab
Instructional Resources	

MODULES

Scheduled Weeks	Module Title	Learning Units	Remarks
Week 1	Introduction	<ul style="list-style-type: none"> • Course Introduction • Motivational Lecture(<i>For further detail please see Page No: 4</i>) • Applications of the course • Institute/Work ethics (<i>For further detail please see Annexure-II at the end</i>) • Job market overview • Recognizing Embedded Instruments • Electrical instruments • Prototyping basics • Circuit Prototyping • Circuit Simulation 	<p style="text-align: center;">Home Assignment</p> <ul style="list-style-type: none"> • Task 1 • Task 2 <p style="text-align: center;"><u>Details may be seen at Annexure-I</u></p>
Week 2	Architecture	<ul style="list-style-type: none"> • Introduction of Microcontroller • Basic code debugging • 8 bit microcontroller • Understanding Architecture of AVR from datasheet • Atmega 328 Development Board • Register level understanding of the Atmega 328 • Success story (<i>For further detail please see Page No: 5 and Annexure-III at the end</i>) • Institute/Work ethics (<i>For further detail please see Annexure-II at the end</i>) 	<ul style="list-style-type: none"> • Task 3 to 7 <p style="text-align: center;"><u>Details may be seen at Annexure-I</u></p> <p style="text-align: center;">Home Assignment</p> <p style="text-align: center;"><u>Details may be seen at Annexure-I</u></p>
Week 3	Programming	<ul style="list-style-type: none"> • Motivational Lecture(<i>For further detail please see Page No: 4</i>) • Types of Microcontroller and introduction to MCU Programming • Coding with Arduino IDE for interest. • Coding on bare metal to control GPIO Ports of the ATmega328 with VS Code. • Basic understanding of C and C++ code syntax like variable (static, const, volatile and extern), array, pointers, conditional statements, functions and different loops. 	<ul style="list-style-type: none"> • Task 8 to 10 <p style="text-align: center;"><u>Details may be seen at Annexure-I</u></p> <p style="text-align: center;">Home Assignment</p> <p style="text-align: center;"><u>Details may be seen at Annexure-I</u></p>

Week 4	Basic Microcontroller application	<ul style="list-style-type: none"> • GPIO Access through bare metal register like DDRx, PORTx and PINx. • Arrays and its applications • Basic understanding to use arrays test on Visual studio and debug it line by line. • Removing delays from the system to run the system more effectively • GPIO PORT usage to dynamic LED array Application • Institute/Work ethics (<i>For further detail please see Annexure-II at the end</i>) • Reading GPIO with PINx registers 	<ul style="list-style-type: none"> • Task 11 to 14 <p><u>Details may be seen at Annexure-I</u></p> <p>Monthly Test1</p>
Week 4	Control Architecture	<ul style="list-style-type: none"> • Automatic control and switching • LCD Displays types and applications • LCD Interfacing • Institute/Work ethics (<i>For further detail please see Annexure-II at the end</i>) 	<ul style="list-style-type: none"> • Task 15 to 17 <p><u>Details may be seen at Annexure-I</u></p>
Week 5	UART and USART protocols	<ul style="list-style-type: none"> • Usage of putty and Tera term software. • Basic Understanding of UART and USART how it works. • Creating own function to access UART registers. • Basic setting of UART like setting baud rate, start and stop bit. • Read UDRx of the ATmega328 and receive the data. • Write and read it over pc through putty or Tera Term. • Usage of UART between controller to controller and controller to PC. 	<ul style="list-style-type: none"> • Task 17 to 22 <p><u>Details may be seen at Annexure-I</u></p>
Week 6	I2C Interface	<ul style="list-style-type: none"> • Basic Understanding of I2C • Registers level of I2C • Communicating with I2C MPU6050 • Access WHO_AM_I from MPU6050 • Writing own driver for MPU6050 • Testing and stabilizing the values with average and running average method. • Writing own driver for RTC module. 	<ul style="list-style-type: none"> • Task 12 <p><u>Details may be seen at Annexure-I</u></p>

		<ul style="list-style-type: none"> • Controller to controller communication. • Using Processing tool to play with 6 dof system. 	
Week 7	SPI Interface	<ul style="list-style-type: none"> • Basic understanding of SPI • Creating own SPI driver on register level. • Attaching MPU9050 and setting it up on register level. • Reading different register like A_x, A_y, A_z, G_x, G_y, G_z and M_x, M_y, M_z. • Using Processing tool to play with 9 dof system. 	<ul style="list-style-type: none"> • Task 13 <p><i><u>Details may be seen at Annexure-I</u></i></p>
Week 8	Interrupts, ADC and Signal Integrity	<ul style="list-style-type: none"> • Software Interrupts • Hardware interrupts • De-bouncing • ADC • Signal Integrity • DMA 	<ul style="list-style-type: none"> •
Week 9	Timers	<ul style="list-style-type: none"> • Getting started with Timer1 of ATmega328. • Setting up pre-scaler and OCR to own clock of the timer. • Basic knowledge of timer and internal interrupts. • Usage of ISR and flags to setup own timer interrupt. • Creating own delay function. • Creating a project without delay only usage of own timer. 	<ul style="list-style-type: none"> • Task 14 • Task 15 <p><i><u>Details may be seen at Annexure-I</u></i></p>
Week 10	Timers PWM And PID Control	<ul style="list-style-type: none"> • Using Timer as Output compare register. • ISR of timer OCR. • How PWM works on register level. • Setting timer1 parameter to get high frequency PWM with 16 bit resolution. • Basic knowledge of transistors to operate motor with PWM and variate speed of motor. • Getting Started with PID control. • Attaching Feedback system to motor to control it through PID. 	<ul style="list-style-type: none"> • Task 16, 17, 18 <p><i><u>Details may be seen at Annexure-I</u></i></p>

Week 11	Enabling Wi-Fi with the Controller	<ul style="list-style-type: none"> • Knowledge of Wi-Fi protocol • Using ESP8266 module • Interface ESP8266 with microcontroller • Make ESP8266 as Wi-Fi client • Make ESP8266 as Wi-Fi hotspot 	<ul style="list-style-type: none"> • Task 18a <p><u>Details may be seen at Annexure-I</u></p>
Week 12	Data Structures and Algorithms & Motivational Lecture	<ul style="list-style-type: none"> • Data Structures and Algorithms\ -> Object Oriented Design ->Pointers and Array based lists 	<ul style="list-style-type: none"> • Task 19 • Task 20 • Task 21 <p><u>Details may be seen at Annexure-I</u></p>
Week 13	Data Structures and Algorithms & Success stories	<ul style="list-style-type: none"> • Data Structures and Algorithms\ ->Link List ->Circular Link List ->Stack ->Queue 	<ul style="list-style-type: none"> • Task 22 <p><u>Details may be seen at Annexure-I</u></p>
Week 14	Midterm		
Week 15	Data Structures and Algorithms & Success stories	<ul style="list-style-type: none"> • Data Structures and Algorithms ->Recursions ->Searching and Sorting Algorithms ->Binary Tree ->AVL Tree 	<ul style="list-style-type: none"> • Home Assignment • Task 23 <p><u>Details may be seen at Annexure-I</u></p>
Week 16	Unified Modeling Language	<ul style="list-style-type: none"> • Fundamental UML Structural Modeling • Class Diagram and Class Modeling • Class Modeling Principles • Object Diagram • Package Diagram 	<ul style="list-style-type: none"> • Task 24 • Task 25 <p><u>Details may be seen at</u></p>

			<u>Annexure-I</u>
Week 17	Ki-Cad PCB Design & Success stories	->Schematic Reading ->Schematic Design on Ki-Cad ->Component Foot Print Designing ->PCB Designing on Ki-Cad	<ul style="list-style-type: none"> • Task 26 <p><u>Details may be seen at Annexure-I</u></p>
Week 18	FreeRTOS & Motivational Lecture	<ul style="list-style-type: none"> • Interrupts • Multitasking and Scheduling • Resource Sharing • Semaphores • Mutex 	<ul style="list-style-type: none"> • Task 27 • Task 28 <p><u>Details may be seen at Annexure-I</u></p>
Week 19	FreeRTOS & Success stories	<ul style="list-style-type: none"> • Message Queues • Pipes • Signaling • Software Timer Management 	<ul style="list-style-type: none"> • Task 29 • Task 30 <p><u>Details may be seen at Annexure-I</u></p> <p>• Monthly Test 5</p>
Week 20	Stepper Motor Interfacing	<ul style="list-style-type: none"> • Stepper Motor Introduction • Applications • Programming 	

Week 21	Logic Analyzers and Debugging	<ul style="list-style-type: none"> • JTAG Interface • SWI Interface • Logic Analyzer 	<ul style="list-style-type: none"> • Task 31 • Task 32 <p><i><u>Details may be seen at Annexure-I</u></i></p>
Week 22	Digital Filters Designs	Designing of filters on MatLab <ul style="list-style-type: none"> • Moving Average Filter • Running Exponential Filter • Butterworth Filter • Low Pass Filter • High Pass Filter • Band Pass Filter • Band Stop Filter 	<ul style="list-style-type: none"> • Task 33 • Task 34 <p><i><u>Details may be seen at Annexure-I</u></i></p>
Week 23	MISRA C Standards	EMBEDDED SOFTWARE SECURITY, SAFETY & QUALITY <ul style="list-style-type: none"> • Job Market Searching • Self-employment • Freelancing sites • Introduction • Fundamentals of Business Development • Entrepreneurship • Startup Funding • Business Incubation and Acceleration • Business Value Statement • Business Model Canvas • Sales and Marketing Strategies • How to Reach Customers and Engage CxOs 	<ul style="list-style-type: none"> • Task 35 • Task 36 • Task 37 <p><i><u>Details may be seen at Annexure-I</u></i></p>

		<ul style="list-style-type: none"> • Stakeholders Power Grid • RACI Model, SWOT Analysis, PEST Analysis • SMART Objectives • OKRs • Cost Management (OPEX, CAPEX, ROCE, etc.) <p>Final Assessment</p>	
Week 24	<p>Prepare quotation for customer</p> <p>Negotiate /Deal with customer and signed MOU</p> <p>& Success stories</p>	<p>Students are introduced to:</p> <p>Prepare quotation for customer</p> <ul style="list-style-type: none"> • Construct your quote clearly and logically • Include all necessary information • Try to send your quotes quickly • Include your contact information like company name and phone number and try to follow up quotes with another message after a couple of days. • If you miss out on a big deal, try to get feedback about why you were not chosen. Was it that your price was too high, or was your quote lacking in some way? • If your business can support it, try setting generous payment terms as an incentive. <p>Negotiate / Deal with customer and signed MOU</p> <ul style="list-style-type: none"> • Term/duration of the MOU. • Cancellation provisions. • MOU review process • Dispute resolution, including (or excluding) legal actions, negotiations, consultations, or executive actions. • Waivers and rights involved in the MOU to make compensation claims related to the execution of the MOU against one another. • Intellectual Property provisions. • Privacy provisions • Methods for transferring funds (if 	<ul style="list-style-type: none"> • Task 40 • Task 41 <p><i><u>Details may be seen at Annexure-I</u></i></p>

		applicable).	
Week 25	<p>Complete the Work done on site</p> <p>Develop professionalism</p> <p>& Motivational Lecture</p>	<p>Students are introduced to:</p> <p>Complete the Work done on site</p> <ul style="list-style-type: none"> ● Collect all related work items ● Develop a process ● Get organized. ● Set a time to review ● Just do it! <p>Develop professionalism</p> <ul style="list-style-type: none"> ● Be productive ● Develop a professional image ● Take the initiative ● Maintain effective work habits ● Manage your time efficiently ● Demonstrate integrity ● Provide excellence. ● Be a problem-solver ● Be resilient ● Communicate effectively ● Develop self-awareness ● Build relationships 	<ul style="list-style-type: none"> ● Task 42 <p><i><u>Details may be seen at Annexure-I</u></i></p>
Week 26	<p>Develop work ethics</p> <p>Follow teamwork environments principles</p> <p>& Success stories</p>	<p>Students are introduced to:</p> <p>Develop work ethics</p> <ul style="list-style-type: none"> ● Practice punctuality. Develop the habit of being on time or early for all appointments. ● Develop professionalism. Professionalism goes beyond a crisp white shirt and tie. ● Cultivate self-discipline. ● Use time wisely. ● Stay balanced. <p>Follow teamwork environments principles</p> <ul style="list-style-type: none"> ● Effective Communication amongst team members. ● Reliable team members. ● Good approach to conflict management. ● Strong and effective leadership. ● Effective allocation of resources. ● Mutual respect amongst team members. ● Constructive working relationship. ● Positive approach to diversity and equality. 	<ul style="list-style-type: none"> ● Task 43 <p><i><u>Details may be seen at Annexure-I</u></i></p>

Week	Task No.	Description
Week-1	Task-1	Usage of electrical meter DMM to measure AC and DC voltage and current.
	Task-2	Basic connection to the controller and usage of potentiometer as well as voltage regulator.
Week-2	Task-3	Use Breadboard to make flashing (Blinking) LED. You have to add the Transistors, Capacitors, 100K Resistors and LEDs. Place all these circuits on Breadboard and Supply Power and Watch the LEDs Blink.
	Task-4	Collecting evidence, analyzing evidence, locating faults, determining and removing causes, rectifying faults and running a systems check.
	Task-5	Making own Arduino with ATmega328 on bread board.
	Task-6	Upload Arduino Bootloader in ATmega328 to make it with Arduino Framework.
Week-3	Task-7	Using Visual Code with platform io instead of Arduino IDE.
	Task-8	Usage of Visual Code creating project for our board.
	Task-9	Basic understanding C++ and C. Logical operations with: <ul style="list-style-type: none"> • If else • switch Write a C Language Program to display count, from 5 to 15 as well as Fibonacci series using following: <ul style="list-style-type: none"> • For Loop • While Loop • Do...while Loop Insert 1,2,3,4, 5 in an array and then read the elements of the array.
	Home Work	Simple Project which utilize all of the C concept. Like array, conditional Statements, loops and pointers.
Week-4	Task-10	Bitwise operations &, , ~ and ^ to set up single register. Se
	Task-11	Adding LED on the board and turn it on with bare metal registers PORTB.
	Task-12	Set pin as input the reading registers to read inputs pins.
	Task-13	Create our own delay and after that remove delay from system.
Week-5	Task-14	Controlling a PORT bit wise to display the output on LED segment.
	Task-15	Actuate control or automate the system.
	Task-16	16x2 LCD control via a single PORT and data transmission.
	Task-17	Attach Button and remove debounce effect without delay as well other techniques.

	Task-x	<p>To verify that you are receiving correct data, you need a wire to connect between the input connectors and power connectors on your own Uno board.</p> <ul style="list-style-type: none"> • Connect one end of the wire to PORT C0 • Connect the other end to GND port • PORT C0 in the Serial Monitor should now read 0.0 volts • Remove the wire from GND and connect it to 5V • PORT C0 should now read approximately 5.0 volts • Remove the wire from 5V and connect it to 3.3V • PORT C0 should now read approximately 3.3 volts • Repeat the same procedure with PORT C1, PORT B0 and D0 • Do you get the same value from the digital port in both 3.3V and 5V?
Week-6	Task-18	Study I2C packet format
	Task-18a	Interface two ESP8266 modules with two different microcontrollers and make one Wi-Fi client and other as Wi-Fi hotspot. Connect Station with Access Point.
	Task-19	Accessing device address of I2C based modules i.e., MPU6050, DS1307
	Task-20	Writing own driver to access data from MPU6050, and read Accelerometer and gyroscope values in 3D environment.
	Task-21	Writing own driver to access data from Real-Time clock module DS1307, and read date and time and make your own watch
Week-7	Task-22	SPI packet format study, Master and slave configurations
	Task-23	Creating own SPI driver on register level
	Task-24	<p>Configuring and reading different register values from MPU9050 module.</p> <ul style="list-style-type: none"> • Reading Register values like A_x, A_y, A_z, G_x, G_y, G_z and M_x, M_y, M_z. • Using running average filter to stabilize the values.
	Task-25	Enable Interrupts on SPI module and read values only when interrupt occurs.
Week-8	Task-26	<p>Enable hardware interrupts on i/o pins and attach buttons on those pins. Also attach an LED on a pin and a buzzer on another pin.</p> <ul style="list-style-type: none"> • When button 1 pressed, turn LED on • When button 2 pressed, turn buzzer on • Otherwise, keep printing a counter value
	Task-27	Configure an ADC pin on register level, attach a potentiometer with analog pin of MCU and read the values from ADC buffer register.
	Task-28	Reading and Writing data using DMA approach
	Task-29	<p>Using different methods to ensure signal integrity</p> <ul style="list-style-type: none"> • Parity bits • CRC (Cyclic Redundancy check) • Checksum • Handshaking and acknowledgement

Week-9	Task-30	Initialize a timer, by setting up its control and status registers and generate an interrupt upon <ul style="list-style-type: none"> • Timer overflows • Timer counter value is equal to compare register value
	Task-31	Create own delay function and blink LED at specific interval while rest of the program will continue its execution.
Week-10	Task-32	Generate PWM signal using Timer1 at <ul style="list-style-type: none"> • Specific duty cycle • Specific frequency
	Task-33	Operate a DC motor, with this PWM signal and hence control speed of the motor.
Week-11	Task-34	Add a PID feedback control system to above dc motor and deploy it to ball and beam system to stabilize it.
Week-12	Task-35	Create static arrays and fill with objects, then find and sort elements in it.
	Task-36	Create pointer using malloc() function, and create arrays on runtime
	Task-37	Create structures and classes for real life objects
Week-13	Task-38	Create an application to store details of items in a book center using linked lists, detail is described below <ul style="list-style-type: none"> • Category of item • Price per item • Total available specific item in book center • Adding, searching and deleting items • Create receipt of the items bought by the customer
	Task-39	Make own Queue and Stacks for data storage and solving algebraic equations.
Week-14		Midterm
Week-15	Task-40	Your task is to extend the List class by writing one method for removing successive duplicate items from lists, and one method for adding them. The squish() method and twin() method will operate on singly-linked lists. For example, if the input list is [0 0 0 0 1 1 0 0 0 3 3 3 1 1 0], the output list is [0 1 0 3 1 0].
Week-16	Task-41	We want to build a device that can help us in showing contents of attach devices, adding/modifying/deleting contents in attached devices. Devices may be USB, CD ROM, Hard Disk. Each device has limited warranty and cost. Build OO Model this problem. And show how you applied various object oriented concepts in it.
Week-17	Task-41	Design a schematic for a circuit to shift output load on WAPDA power

		supply or on turn on generator when WAPDA supply is OFF and start the generator and shift load on it. When WAPDA electricity comes back, shift the load back on WAPDA supply.
Week-18	Task-42	Demonstrate the steps needed to create two simple tasks and execute them.
	Task-43	Create task with different priorities.
	Task-44	Blocking when requesting semaphore to write data to memory.
	Task-45	Using a binary Semaphore to synchronize a task with and interrupt.
Week-19	Task-46	Blocking when reading and writing data to Queue
	Task-47	Create a pipe, one task write data in it while other task read data from it.
Week-20	Task-48	Control position and speed of stepper motor using potentiometer.
Week-21	Task-49	Analyzing data transfer from UART, I2C and SPI communication protocols using logic analyzer
	Task-50	Debug a sketch using JTAG based debugger.
	Task-51	Debug a sketch using SWI based debugger.
Week-22	Task-29	Designing of filters on MatLab and implementing in on signals from multiple sensors. Filter to be covered, <ul style="list-style-type: none"> • Moving Average Filter • Running Exponential Filter • Butterworth Filter • Low Pass Filter • High Pass Filter • Band Pass Filter • Band Stop Filter
Week-23		Project week
Week-20	Task-31	Calculate power generation of wind turbine for a given scenario.
	Task-32	Repair and maintain vertical axis wind turbine system.
Week-21	Task-33	Analyze job in local market
	Task-34	Download professional CV template from any good site (https://www.coolfreecv.com or relevant) <ul style="list-style-type: none"> • Add Personal Information • Add Educational details • Add Experience/Portfolio • Add contact details/profile links <p>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.</p>

		Step 6: Update your profile following the style of shortlisted profiles.
Week-22	Task-35	Analyze job demand in international country.
	Task-36	Apply for job in abroad.
	Task-37	Analyze customer demand
Week-23	Task-38	Perform cost analysis as per customer demand.
	Task-39	Conduct market survey for project estimation
Week-24	Task-40	Prepare quotation for customer
	Task-41	Negotiate / Deal with customer and signed MOU
Week-25	Task-42	Complete the Work done on site
Week-26	Task-43	Develop work ethics

Annexure-III

SUGGESTIVE FORMAT AND SEQUENCE ORDER OF MOTIVATIONAL LECTURE.

Mentor

Mentors are provided an observation checklist form to evaluate and share their observational feedback on how students within each team engage and collaborate in a learning environment. The checklist is provided at two different points: Once towards the end of the course. The checklists are an opportunity for mentors to share their unique perspective on group dynamics based on various team activities, gameplay sessions, pitch preparation, and other sessions, giving insights on the nature of communication and teamwork taking place and how both learning outcomes and the student experience can be improved in the future.

Session- 1 (Communication):

Please find below an overview of the activities taking place Session plan that will support your delivery and an overview of this session's activity.

Session- 1 OVERVIEW
Aims and Objectives:
<ul style="list-style-type: none"> • To introduce the communication skills and how it will work • Get to know mentor and team - build rapport and develop a strong sense of a team • Provide an introduction to communication skills • Team to collaborate on an activity sheet developing their communication, teamwork, and problem-solving • Gain an understanding of participants' own communication skills rating at the start of the program

Activity:	Participant Time	Teacher Time	Mentor Time
Intro Attend and contribute to the scheduled.			
Understand good communication skills and how it works.			
Understand what good communication skills mean			
Understand what skills are important for good communication skills			

Key learning outcomes:	Resources:	Enterprise skills developed:
<ul style="list-style-type: none"> • Understand the communication skills and how it works. • Understand what communication skills mean • Understand what skills are important for communication skills 	<ul style="list-style-type: none"> • Podium • Projector • Computer • Flip Chart • Marker 	<ul style="list-style-type: none"> • Communication • Self Confidence • Teamwork

Schedule	Mentor Should do
Welcome: 5 min	Short welcome and ask the Mentor to introduce him/herself. Provide a brief welcome to the qualification for the class. Note for Instructor: Throughout this session, please monitor the session to ensure nothing inappropriate is being happened.
Icebreaker: 10 min	Start your session by delivering an icebreaker, this will enable you and your team to start to build rapport and create a team presentation for the tasks ahead. The icebreaker below should work well at introductions and encouraging communication, but feel free to use others if you think they are more appropriate. It is important to encourage young people to get to know each other and build strong team links during the first hour; this will help to increase their motivation and communication throughout the sessions.
Introduction & Onboarding: 20mins	Provide a brief introduction of the qualification to the class and play the “Onboarding Video or Presentation”. In your introduction cover the following: <ol style="list-style-type: none"> 1. Explanation of the program and structure. (Kamyab jawan Program) 2. How you will use your communication skills in your professional life. 3. Key contacts and key information – e.g. role of teacher, mentor, and SEED. Policies and procedures (user agreements and “contact us” section). Everyone to go to the Group Rules tab at the top of their screen, read out the rules, and ask everyone to verbally agree. Ensure that the consequences are clear for using the platform outside of hours. (9am-8pm) 4. What is up next for the next 2 weeks ahead so young people know what to expect (see pages 5-7 for an overview of the

	challenge). Allow young people to ask any questions about the session topic.
Team Activity Planning: 30 minutes	<p>MENTOR: Explain to the whole team that you will now be planning how to collaborate for the first and second collaborative Team Activities that will take place outside of the session. There will not be another session until the next session so this step is required because communicating and making decisions outside of a session requires a different strategy that must be agreed upon so that everyone knows what they are doing for this activity and how.</p> <ul style="list-style-type: none"> • “IDENTIFY ENTREPRENEURS” TEAM ACTIVITY • “BRAINSTORMING SOCIAL PROBLEMS” TEAM ACTIVITY” <p><i>As a team, collaborate on a creative brainstorm on social problems in your community. Vote on the areas you feel most passionate about as a team, then write down what change you would like to see happen.</i></p> <p>Make sure the teams have the opportunity to talk about how they want to work as a team through the activities e.g. when they want to complete the activities, how to communicate, the role of the project manager, etc. Make sure you allocate each young person a specific week that they are the project manager for the weekly activities and make a note of this.</p> <p>Type up notes for their strategy if this is helpful - it can be included underneath the Team Contract.</p>
Session Close: 5 minutes	<p>MENTOR: Close the session with the opportunity for anyone to ask any remaining questions.</p> <p>Instructor: Facilitate the wrap-up of the session. A quick reminder of what is coming up next and when the next session will be.</p>

Motivational Lectures and Success Stories (Course Outlines)

Sr #	Topic title	Contents	Theme
1	Success stories	<ol style="list-style-type: none"> 1. Story of Skill worker who get good job. 2. Entrepreneur /self-business 3. Freelancer 	<ol style="list-style-type: none"> 1. Family Background 2. How to get Training 3. How to get job 4. Success trait 5. Few word of advice for youth
2	Motivational Lectures	<ol style="list-style-type: none"> 1. Soft skills 2. work Ethics 3. Personality Grooming 	<p>Good Habits</p> <ul style="list-style-type: none"> • Punctuality • Honesty • Positive attitude <p>Interpersonal skills</p> <ul style="list-style-type: none"> • Determinant • Consistent • Welling worker • Team work • Initiative • Hardworking • Creative • Enthusiastic • Goal oriented • Self-motivated • Communication • Loyalty

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-centered on the importance of work and manifested by determination or desire to work hard.

The following ten work ethics 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 weight and help others who are struggling. Recognize when to speak up with an idea 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 lifetime

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 your work, 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. Take 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 work situations and the application of new or different skills.

10. Respect:

Work hard, work to the 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.