CURRICULUM

OF

PG DIPLOMA IN INTERNET OF THINGS (IOT)

ONE YEAR (TWO SEMESTER)

INSTITUTE OF RESEARCH, DEVELOPMENT &TRAINING

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APPROVED IN CDC MEETING OF BOARD OF TECHNICAL EDUCATION,U.P,LUCKNOW DATED 26-05-2022

PREFACE

An important issue generally debated amongst the planners and academician's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by the Department of Technical Education, UP to run new age diploma programmes as per the needs of the industry and making them NSQF compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been developed & revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected from the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much-needed dynamism in the system.

Manoj Kumar
Director
Institute of Research Development & Training
Kanpur, U.P.

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ACKNOWLEDGEMENTS

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SALIENT FEATURES OF CURRICULUM

1.   **Title of the course**   :   **PG Diploma in Internet of Things (IOT)**
2.   **Duration of Course**   :   **One Year**
3.   **Type of the course**   :   **Full time**
4.   **Pattern of course**   :   **Semester**
5.   **Intake**   :   **75**
6.   **Admission Qualification   :   Graduation**
7.   **Ratio between theory and Practice: 1: 2 (Approx.)**
8.   **Student Centered Activities**

A provision of 3-6 hrs. per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities, disaster management and environmental safety etc.

9.   **Project work**

A project work in the 1st & 2nd semester has been included in the curriculum to enable the students to get familiar with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2. EMPLOYMENT OPPORTUNITIES FOR PG DIPLOMA HOLDERS IN Internet of Things (IOT)

PG Diploma holders in Internet of Things (IOT) can find employment in following sectors:

- Service Division (IT enabled services, maintenance service and installation of computer services)
- Software Development and Testing Industries
- Web Development and Testing Industries
- Mobile Applications Development and Testing Industries
- Lab. Assistant/Technician
- Hospitals/Healthcare/Institutions/Schools
- Cloud Services Support Engineer
- Telecommunication Sector
- Teaching Organizations (Polytechnics, Vocational Institutions etc)
- Networking (LAN, WAN etc)
- Defence Services/Police Services/Cyber Services/Forensic Services

POST GRADUATE DIPLOMA IN INTERNET OF THINGS (IOT)

NEED:

The number of IOT-connected devices is expected to touch 43 billion by 2023, according to McKinsey. The Internet of Things industry continues to grow in market size. Digitalist predicts IOT's economic impact could reach $11 trillion, or 11 percent of global economic value by 2025. Ericsson has forecasted that the number of cellular IOT connections is expected to reach 3.5 Billion in 2023, increasing at a CAGR of 30%.

Increased penetration of affordable devices, combined with cloud computing, analytics and rising consumer expectations is driving the rapid growth of the IOT market. IT, Automotive and Heavy Engineering are only some of the industries which are driving the demand for IOT solutions.

Technical Education(Diploma Sector)U.P. offers a post-graduate certificate in Internet of Things (IOT) for working professionals. An one Year programme that covers software, hardware, application systems, big data, and their interplay in IOT systems.

The programme is designed for engineers who wish to transition to IOT career opportunities in sectors such as IT, Automotive, Manufacturing, Energy, Telecom and Logistics. Engineers currently working in organisations that either provide IOT products & services, or design & implement IOT solutions for transforming their own business should also consider applying to this programme.

OBJECTIVE OF THE COURSE:

This course focuses on the latest microcontrollers with application development, product design and prototyping. Ideally suited for engineering students and graduates with a basic understanding of electronics and microprocessors. The Internet of Things (IOT) is the next wave, world is going to witness. Today we live in an era of connected devices (mobile phones, computers etc.), the future is of connected things (eg: home appliances, vehicles, lamp-posts, personal accessories, your pets, industrial equipments and everything which you use in day-to-day life). Internet of Things is a term given to the attempt of connecting objects to the internet and also to each other - allowing people and objects themselves to analyze data from various sources in real-time and take necessary actions in an intelligent fashion.

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LEARNING OUTCOMES:

- After the completion of the course, the students will be able design some IOT based prototypes

- Exposure with different families and architectures of Internet of things and tools such as ARM Microcontrollers, Embedded operating systems, Wireless sensor networks, IOT architecture and protocols etc.

- Expertise required to design any IOT products (H/w or S/w or both) based on any of the above devices.

-

DURATION OF THE COURSE :   1 Year

Pattern: Semester

MINIMUM ELIGIBILITY: Graduate

STUDY & EVALUATION SCHEME FOR ONE YEAR (TWO SEMESTER)

PG DIPLOMA in INTERNET OF THINGS (IOT)

(Effective from session 2022-23)

I SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		*Th*	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
1.1	INTRODUCTION TO IOT	06	-	-	05	20	-	20	50	2 ½	-	-	50	70
1.2	EMBEDDED C WITH ARDUINO	06	-	08	06	20	30	50	50	2 ½	50	3	100	150
1.3	PYTHON PROGRAMMING	06	-	08	06	20	30	50	50	2 ½	50	3	100	150
1.4	BASICS OF SENSORS AND ACTUATORS	06	-	-	05	20	-	20	50	2 ½		-	50	70
1.5	MINOR PROJECT	-	-	06	04	-	50	50	-	-	50	3	50	100
	#Student Centred Activities	-	-	2	1	-	30	30	-	-	-	-	-	30
	Total	24	-	24	27	80	140	220	200	-	150	-	350	570

\#   Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, self study etc.

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II SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
						INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
2.1	THE IOT MICROCONTROLLER PLATFORM	6	-	6	6	20	30	50	50	2 ½	50	3	100	150
2.2	IOT: WIRELESS TECHNOLOGY, SECURITY & COMMUNICATION PROTOCOLS	6	-	6	6	20	30	50	50	2 ½	50	3	100	150
2.3	IOT USING RASPBERRY Pi	6	-	6	6	20	30	50	50	2 ½	50	3	100	150
2.4	IOT PROJECT/Seminar	-	-	10	2	-	50	50	-	-	100	3	100	150
	#Student Centred Activities	-	-	2	1	-	30	30	-	-	-	-	-	30
	Total	**18**	**-**	**30**	**21**	**60**	**170**	**230**	**150**	**-**	**250**	**-**	**400**	**630**

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GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 30 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 10 Marks for general behaviour and discipline
    (By HODs in consultation with all the teachers of the department)

ii. 5 Marks for attendance as per following:
    (By HODs in consultation with all the teachers of the department)

    a) 75 - 80%   2 Marks
    b) 80 - 85%   4 Marks
    c) Above 85%   5 Marks

iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:
    (By In-charge Sports/NCC/Cultural/Co-curricular/NSS)

    a) 15 - State/National Level participation
    b) 10 - Participation in two of above activities
    c) 5   - Inter-Polytechnic level participation

Note: There should be no marks for attendance in the internal sessional of different subjects.

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1.1 INTRODUCTION TO IOT

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RATIONALE:

The Internet of Things is a new Eco-system of actual items that are, associated, connected and open through the web in all real time. This course will enable Graduate students to understand the basics building blocks of Internet of things and its related architecture and protocols.

It will introduces them and aware them about areas where Internet of Things can be applied. Students will learn about the middleware, hardware for Internet of Things.

LEARNING OUTCOMES :

After undergoing the subject, students will be able to:

- Understand the concepts of Internet of Things.
- Understand what constitutes an IOT design solution
- Identify the sensors and other devices needed for different IOT solutions
- Understand the component parts of an IOT network and its connections build small IOT applications.

DETAILED CONTENTS:

Unit 1: IOT - What is the Internet of Things(IOT) and why is it important? How does the Internet of Things (IOT) affect our everyday lives? How does IOT work? Describe the different parts or components of IOT Elements of an IOT Ecosphere, Technology. Trends of IOT and implications, Overview of Governance, Privacy and Security Issues.

Unit 2: IOT Protocols are utilized to associate low-power IOT gadgets. They give correspondence equipment on the client side - without the requirement for any web association. The availability in IOT information conventions and norms is through a wired or cell organization.

IOT PROTOCOLS - MQTT (Message Queuing Telemetry Transport), It features a publisher-subscriber messaging model and allows for simple data flow between different devices.

CoAP (Constrained Application Protocol), A CoAp (Constrained Application Protocol) is an application layer protocol. It's designed to address the needs of HTTP-based IOT systems.

AMQP (Advanced Message Queuing Protocol) **,** An Advanced Message Queuing Protocol (AMQP) is an open standard application layer protocol used for transactional messages between server.

Protocol Standardization for IOT – Efforts – M2M , WSN Protocols ,SCADA and RFID Protocols.

 Issues with Internet of Things Standardization .

Unified Data Standards Protocols IEEE802.15.4

Network Protocols - LoRaWan , Z-Wave, Modbus, Wifi, Bluetooth KNX ,Zigbee–

Unit 3: IOT ARCHITECTURE – The architecture of IOT depends upon its functionality and implementation in different sectors. An IOT Architecture is a system of numerous elements such as sensors, actuators, protocols, cloud services, and layers that make up an IOT networking system.

Resource model and Abstraction of 3-Layer Architecture,4-Layer Architecture ,5-Layer Architecture work.

Types of IOT Layer-

Perception Layer-Connectivity Layer-Edge Layer-Processing Layer-Application Layer-Business Layer

Security Layer- security has become one of the main necessities of IT architecture. Data breach, tracking malicious software, and hacking are the main challenges with Security Layer in integrating IOT systems.

Design Principles- IOT Devices and deployment models- IOTivity : An Open source IOT stack -

Unit 4: WEB OF THINGS - Web of Things versus Internet of Things,two Pillars of the Web

ARCHITECTURE.

Standardization for Web of Things– Platform Middleware for Web of Things .

Unit 5 :IOT APPLICATIONS -IOT Applications for industry: Future Concepts, Smart City, Smart Self Driving car, IOT in Farming, Fitness Trackers, IOT Connected Factories, IOT Hospitality and Tourism, Retai IOT.

INSTRUCTIONAL STRATEGY:

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss case studies with students to feel the importance of the subject .

MEANS OF ASSESSMENT:

Assignments and quiz/class tests, mid-term and end-term written tests viva-voce.

SUGGESTED DISTRIBUTION OF TOTAL PERIODS & MARKS :

Unit No.	Total Periods	Marks (%)
1	15	16
2	18	22
3	18	22
4	18	22
5	15	18
Total	**84**	**100**

RECOMMEND BOOK & REFERENCES:

- The Internet of Things: Connecting Objects to the Web,Wiley PublisherHakimaChaouchi
- Internet of Things: A Hands On Approach, University Press,VijayMadisetti, ArshdeepBahga.
- 21 Internet Of Things (IOT) Experiments,BPB Publications YashavantKanetkar
- Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.

- IOT for Beginners by Vibha Soni.

- Internet of Things and its Applications by Satish Jain.

- David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
- Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
- Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects).

Websites for Reference:

http://www.spoken-tutorial.org

http://swayam.gov.in

https://www.nabto.com/guide-iOT-protocols-standards/

https://Medium.com

https://Analyticalvidhya.com

Video Link:

Title	Expert Name	Affiliation	Weblink
(Introduction To Industry 4.0 And Industrial Internet Of Things	Dr.Sudip Mishra	IIT Khargpur	https://www.youtube.com/watch?v=p7kYStiASLo
Internet of things	Dr.Sudip Mishra	IIT Khargpur	https://www.youtube.com/playlist?list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE

1.2 EMBEDDED C WITH ARDUINO

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RATIONALE: The PG diploma holders in IOT needs to understand Arduino fundamentals and programming in C concepts. They should be able to operate Arduino boards. Hence this subject is introduced in the curriculum.

LEARNING OUTCOMES:

After undergoing the subject, the students will be able to:

- Understand the components of an Arduino i.e. hardware and software components, which are essential for working with Arduino.
- Understand the basic concepts of programming.
- including reading schematics (electronics diagrams)
- Learn how to prototype circuits with a breadboard
- Learn the Arduino programming language and IDE
- Program basic Arduino examples
- Prototype circuits and connect them to the Arduino

DETAILED CONTENTS:

Unit 1: Introduction to Arduino:

Overview, Board description, Installation, Pin configuration and architecture, Device and platform features., Concept of digital and analog ports, Familiarizing with Arduino Interfacing Board, Introduction to Embedded C and Arduino platform

Unit 2: Programming Basics:
Arduino data types, Variables and constants, Operators, Control Statements, Loops, Arrays, Pointer, String, functions

Unit 3: Arduino Functions:

 Pins Configured as INPUT, Pull-up Resistors, Pins Configured as OUTPUT, pinMode() Function, digitalWrite() Function, analogRead() function, Arduino Interrupts

Unit 4: Arduino Time:

 Incorporating Arduino time, delay () function, delayMicroseconds () function, millis () function, micros() function .

Unit 5: Arduino Displays:

 Working with Serial Monitor, Line graph via serial monitor, Interfacing a 8 bit LCD to Arduino, Fixed one line static message display, Running message display, Using the LCD Library of Arduino.

Unit 6: Arduino Sensors:

 Arduino – Humidity Sensor, Arduino – Temperature Sensor, Arduino – Water Detector / Sensor, Arduino – PIR Sensor, Arduino – Ultrasonic Sensor, Arduino – Connecting Switch (Magnetic relay switches)

Unit 7: Arduino Secondary Integrations:

Types of Relays, Controlling Electrical appliances with electromagnetic relays, working of a matrix keypad, Using the keypad library to interface with Arduino, Interfacing Servo motors to Arduino, Interfacing a RF Module

Unit 8: Giving Input to the Controller:

 Using serial input, Controlling LEDs with keys, Keys as toggle switch, interfacing a piezo Buzzer, Using a buzzer as an alarm unit

Unit 9: Arduino Communications:

Parallel Communication, Serial Communication Modules, Types of Serial Communications, Arduino UART, GSM/GPRS Arduino Interfacing

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LIST OF PRACTICALS:

 1. Installation of Arduino IDE

 2. Programming exercise in C language.

 3. Programming exercise on Arduino with C language.

 4. Programming exercise on Arduino-I/O function.

 5. Programming exercise on Advance Arduino-I/O function

 6. Programming exercise on character function.

 7. Programming exercise on Math Libraries.

8. Programming exercise on Trigonometric function.

9. Working Various project using Arduino (Blinking LED, Fading LED, Reading Analog Voltage, Voltmeter, Ammeter etc)

INSTRUCTIONAL STRATEGY :

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss case studies with students to feel the importance of the subject, since this subject is practical oriented, the teacher should demonstrate functioning of various sensors and demonstrate building of IOT applications. Solution to various regression and classification problems should also be built

 MEANS OF ASSESSMENT :

Assignments and quiz/class tests, mid-term and end-term written tests – viva-voce – Actual laboratory and practical work exercises – Software installation, operation, development

RECOMMENDED BOOKS & REFERNCE:

1. Arduino Projects For Engineers ,BPB Publications ,Neerparaj Rai
2. Beginning C for Arduino, Apress,Jack purdum
3. C programming for Arduino,Packt publishing, Julien Bayle
4. Embedded Controllers Using C and Arduino by James M. Fiore
5. https://onlinecourses.swayam2.ac.in/aic20_sp04
6. e-books/e-tools/relevant software to be used as recommended by AICTE/UPBTE/NITTTR, Chandigarh.
7. https://www.tutorialspoint.com/arduino/index.htm

LIST OF COMPONENTS

1. One kit for 3-4 students : Arduino Uno, sensors(Bluetooth module(HC05), MQ135, DHT11, breadboard , LCD, 2-relay module etc)

2. Consumables : LED, button, connecting wires, LDR, LM35, battery, etc

SUGGESTED DISTRIBUTION OF TOTAL PERIODS & MARKS

Unit No.	Total Periods	Marks (%)
1	8	15
2	12	15
3	10	10
4	8	10
5	10	10
6	8	10
7	8	10
8	10	10
9	10	10
Total	**84**	**100**

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1.3 PYTHON PROGRAMMING

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RATIONALE:

This course introduces to the students the Python language. Upon completion of this course, the student will be able to write non trivial Python programs dealing with a wide variety of subject matter domains. Topics include language components, the IDLE/IDE environment, control flow constructs, strings, I/O, collections, classes, modules, and regular expressions.

LEARNING OUTCOMES

After undergoing the course, the students will be able to:

Execute Python code in a variety of environments

- Use correct Python syntax in Python programs
- Use the correct Python control flow construct
- Write Python programs using various collection data types
- Write home grown Python functions
- Use standard Python modules such as os, sys, math, and time
- Trap various errors via the Python Exception Handling model
- Use the IO model in Python to read and write disk files
- Create their own classes and use existing Python classes.
- Understand and use the Object Oriented paradigm in Python programs
- Use the Python Regular Expression capabilities for data verification

• DETAILED CONTENTS

1. Introduction

- Brief History of Python
- Python Versions
- Installing Python
- Environment Variables
- Executing Python from the Command Line
- IDLE
- Editing Python Files
- Python Documentation
- Getting Help
- Dynamic Types
- Python Reserved Words
- Naming Conventions

2. Basic Python Syntax

- Basic Syntax Comments
- String Values
- String Methods
- The format Method
- String Operators
- Numeric Data Types
- Conversion Functions
- Simple Output
- Simple Input
- The % Method
- The print Function

3. Language Components

- Indenting Requirements
- The if Statement
- Relational and Logical Operators
- Bit Wise Operators
- The while Loop
- Break and continue
- The for Loop

4. Collections

- Introduction
- Lists
- Tuples
- Sets
- Dictionaries
- Sorting Dictionaries
- Copying Collections
- Summary

5. Functions

- Introduction
- Defining Your Own Functions
- Parameters
- Function Documentation
- Keyword and Optional Parameters
- Passing Collections to a Function
- Variable Number of Arguments Scope
- Functions - "First Class Citizens"
- Passing Functions to a Function
- Map
- Filter
- Mapping Functions in a Dictionary
- Lambda
- Inner Functions
- Closures

6. Modules

- Modules
- Standard Modules – sys
- Standard Modules – math
- Standard Modules – time
- The dir Function

7. Exceptions

- Errors
- Runtime Errors
- The Exception Model
- Exception Hierarchy
- Handling Multiple Exceptions
- Raise
- Assert

8. Input and Output

- Introduction
- Data Streams
- Creating Your Own Data Streams
- Access Modes
- Writing Data to a File
- Reading Data From a File
- Additional File Methods
- Using Pipes as Data Streams
- Handling IO Exceptions

9. Classes in Python

- Classes in Python
- Principles of Object Orientation Creating Classes
- Instance Methods
- File Organization
- Special Methods
- Class Variables
- Inheritance
- Polymorphism

10. Regular Expressions

- Introduction
- Simple Character Matches
- Special Characters
- Character Classes
- Quantifiers
- The Dot Character
- Greedy Matches
- Grouping
- Matching at Beginning or End
- Match Objects
- Substituting
- Splitting a String
- Compiling Regular Expressions
- Flags

LIST OF PRACTICALS

1. Getting started with Python and IDLE in interactive and batch modes

2. What do the following string methods do?

- lower

- count

- replace

3. Write instructions to perform each of the steps below

(a) Create a string containing at least five words and store it in a variable.

(b) Print out the string.

(c) Convert the string to a list of words using the string split method.

 (d) Sort the list into reverse alphabetical order using some of the list methods (you might need to use dir(list) or help(list) to find appropriate methods).

(e) Print out the sorted, reversed list of words.

4. Write a program that determines whether a given number is prime or not prime.

5. Find all numbers which are multiple of 17, but not the multiple of 5, between 2000 -2500?

6. Swap two integer numbers using a temporary variable. Repeat the exercise using the code format: a, b = b, a. Verify your results in both the cases.

7. Find the largest of n numbers, using a user defined function largest().

8. Write a function my Reverse() which receives a string as an input and returns the reverse of the string.

9. Check if a given string is palindrome or not.

10. WAP to convert Celsius to Fahrenheit

11. Find the ASCII value of characters

12. WAP for simple calculator

INSTRUCTIONAL STRATEGY

Teachers should put emphasis on practicals and experts from industries may be invited to deliver lectures and share experiences with the students.

MEANS OF ASSESSMENT

Assignments and quiz/class tests, mid-term and end-term written tests–

Software installation, operation, development–

Actual laboratory and practical work exercises–

RECOMMENDED BOOKS & REFERNCES:

1. Learning Python by Mark Lutz; Pratham Books, Bangalore

2. Foundations of Python Network Programming by John Goerzen and Brandeu Rhodes; ApresseBook distributed by Springer   Science and Business Media, New York

3. Dive Into Python by Mark Pilgrim; Pratham Books, Bangalore

4. Think Python by Allen B. Downey; O'Reily Media

5. Python Programming For Beginners: A Must Read Introduction to Python Programming by Robert Richards; Pratham Books, Bangalore

6. e-books/e-tools/relevant software to be used as recommended by AICTE/NITTTR, Chandigarh. Websites for Reference: http://swayam.gov.in

SUGGESTED DISTRIBUTION OF TOTAL PERIODS & MARKS

Unit No.	Total Periods	Marks (%)
1	06	08
2	08	10
3	08	10
4	08	10
5	12	15
6	06	08
7	07	08
8	07	08
9	12	15
10	10	08
Total	**84**	**100**

1.4 BASICS OF SENSORS AND ACTUATORS

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RATIONALE:

The Internet of Things (IOT) is defined as the network of physical objects, things that are embedded with sensors, actuators, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet

1. This program aims to train students to be equipped with a solid theoretical foundation about sensors and actuators.
After doing this course, students should be able to understand how information from physical devices in the real world gets communicated to Smartphone processors.

2. To introduce the terminology, technology and its applications.

LEARNING OUTCOME:

After completion of the course, the students will be able to

1. Identify the sensors and other devices needed for different IoT solutions
2. Use concepts in common methods for converting a physical parameter into an electrical quantity.
3. To understand the role of Sensors, transducers in measuring physical quantities
4. Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
5. Evaluate performance characteristics of different types of sensors
6. Working and characteristics of actuators.

PREREQUISITES: Basic electronics, Measurements and Instruments.

DETAILED CONTENTS :

Unit-1 Sensor : Introduction to Sensors, Sensor Characteristics, Classification of Sensors Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal. Application of sensors.

Unit-2 Types of sensors- Position, Motion ,Velocity and Acceleration ,Force, Pressure, Flow, Humidity, Light, Radiation, Temperature, Image, Gas, Ultrasonic, Infrared Sensors, Biosensors, Micro and Nano sensors. Criteria to choose a sensor.

Unit-3 Actuator: Introduction to Actuators, Actuator Characteristics, Classification of Actuators-Electrical Actuators, Electromechanical Actuators, Electromagnetic Actuators, Hydraulic Actuators, Pneumatic Actuators, Smart Material Actuators, Micro actuators. Working principles of Actuators, moving or controlling system e.g. DC motor. Difference between Sensors and Actuators in IoT Device. Application of actuators.

Unit-4 Sensor Materials and Processing Techniques: Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials. Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

INSTRUCTIONAL STRATEGY:

Some of the topics may be taught using question/answer, assignments, seminar, Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams)) or case study method. The teacher will discuss case studies with students to assert the importance of the subject, since this subject is theory oriented, the teacher can demonstrate functioning of various sensors and actuators and demonstrate related IoT applications and meaningful connections between skills and ideas, and reallife situations.

MEANS OF ASSESSMENT:

- Assignments and quiz/class tests, Efficient delivery using seminar presentations,
- mid-term and end-term written tests.

RECOMMENDED BOOKS & REFERENCES:

- The Internet of Things: Connecting Objects to the Web,Wiley PublisherHakimaChaouchi
- Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.
- Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010.
- Internet of Things: A Hands On Approach, University Press,VijayMadisetti, ArshdeepBahga.
- Internet of Things and its Applications by Satish Jain.

Websites for Reference:

- http://www.spoken-tutorial.org
- http://swayam.gov.in
- https://kanchiuniv.ac.in
- https://nptel.ac.in/courses/108108147

SUGGESTED DISTRIBUTION OF TOTALS PERIODS & MARKS :

Topic No.	Total Periods	Marks (%)
1.	28	33
2.	14	17
3.	18	21
4.	24	29
Total	**84**	100

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1.5 MINOR PROJECT WORK

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LEARNING OUTCOMES

- After undergoing through this subject, the student will be able to handle IOT tools and embedded devices and can control them. They can create own network of smart devices. They will be able to program Arduino for creating small projects.
- Able to Demonstrate skill and knowledge of current IOT tools and techniques.
- Develop leadership abilities and work with the team.
- Minor Project work aims at exposing the students to various industries dealing with this subjects. It is expected from them to get acquainted with controlling embedded electronic devices without physical presence of human.
- As a minor project activity, each student is supposed to prepare a detail project report of the project done by him/her. The students should be guided by the respective subject teachers. Teacher may guide groups of 4 to 5 students. The teacher & Examiner will conduct performance assessment of students.

Criteria for assessment will be as follows:

Internal Assessment

	Criteria	Weightage
(a)	Attendance and Punctuality	15%
(b)	Initiative in performing tasks/ knowledge about the project	40%
(c)	Relation with people	15%
(d)	Report Writing	30%
	Total	100%

External Assessment

	Criteria	Weightage
(a)	Project Report	30%
(b)	Execution of Project	40%
(c)	Viva on the project and related subject.	30%

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	Total	100%

Student Centred Activities

The purpose of this subject is to enhance the skills of students in following areas:

1. English proficiency

2. Group discussion.

3- Presentation skills

2.1 THE IOT MICROCONTROLLER PLATFROM

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RATIONALE:

The PG diploma holders in IOT needs to microcontroller fundamentals and platforms used in iOT. They should be able to operate microcontroller platforms . Hence this subject is introduced in the curriculum.

LEARNING OUTCOMES :

After undergoing the subject, the students will be able to:

- Identify the components of microcontroller.
- Identify a detailed s/w & h/w structure of the Microprocessor and microcontroller.
- Distinguish and analyze the properties of Microprocessors & Microcontrollers.
- Analyze the data transfer information through serial & parallel ports.
- Train their practical knowledge through laboratory experiments.
- Program the Arduino microcontroller to make the circuits work
- Connect the Arduino microcontroller to a serial terminal to understand communication and stand-alone use
- Explore the provided example code and online resources for extending knowledge about the capabilities of the Arduino microcontroller

DETAILED CONTENTS

Unit-1 Introduction to Microcontroller:
 Overview, Features of microcontroller, Advantage and disadvantage of microcontroller, Introduction to Embedded Processors -Overview of the 8051 family, pin diagram explanation, internal diagram 8051.

Unit-2 Classification of Microcontroller:

Bus Width, Memory Structure, Instruction Set, Number of input/ output pins

Unit-3 Components of Microcontroller:

CPU, Memory, Input and Output ports, System Bus, Timers and counters, Serial Port, Interrupt Control, Analog to digital convertor, Digital to Analog Convertor

Unit-4 Types of Microcontrollers:

 Microcontroller 8051, AVR Microcontroller, PIC Microcontroller, ARM Microcontroller, Renesas Microcontroller, application in IOT

Unit-5 Interfacing of memory, intelligent LCD, 8255, ADC, DAC, LED display, Pulse Measurement - D/A and A/D conversion- Stepper Motor.

LIST OF PRACTICALS

1. Interfacing Light Emitting Diode (LED)- Blinking LED
2. Interfacing Button and LED – LED blinking when button is pressed.
3. Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
4. Interfacing Temperature Sensor (LM35) and/or humidity sensor (e.g. DHT11)
5. Interfacing Liquid Crystal Display (LCD) – display data generated by sensor on LCD
6. Interfacing Air Quality Sensor-pollution (e.g. MQ135) - display data on LCD, switch on LED when data sensed is higher than specified value.
7. Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
8. Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
9. Study and implement serial communication by interfacing microcontroller with a computer.
10. Study and implement parallel data communication by interfacing microcontroller with a LCD.
11. Interface a ADC and a temperature sensor to measure temperature

12. Interface a DAC & Generate a stair case wave form – with step duration and no. of steps as variables
13. Flash a LED connected at a specified output port terminal

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss case studies with students to feel the importance of the subject, since this subject is practical oriented, the teacher should demonstrate functioning of various sensors and demonstrate building of IOT applications. Solution to various regression and classification problems should also be built

MEANS OF ASSESSMENT – Assignments and quiz/class tests, mid-term and end-term written tests – viva-voce – Actual laboratory and practical work exercises – Software installation, operation, development

RECOMMENDED BOOKS & REFERENCES:

1. J.L. Antonakos, An Introduction to the Intel Family of Microprocessors, Pearson, 1999.
2. Barry B. Brey, The Intel Microprocessors, (7/e), Eastern Economy Edition , 2006.
3. M.A. Mazidi & J.C. Mazidi Microcontroller and Embedded systems using Assembly & C. (2/e), Pearson Education, 2007
4. Kenneth J Ayala, The 8051 Microcontroller , (3/e), Thomson Delmar Learning, 2004.
5. I. Scott MacKenzie and Raphael C.W. Phan. The 8051 Microcontroller.(4/e), Pearson education, 2008.
6. Micro controllers & its applications by B.S. Chhabra, Dhanpat Rai Pub. Co., India

SUGGESTED DISTRIBUTION OF TOTAL PERIODS & MARKS

Unit No.	Total Periods	Marks (%)
1	18	20
2	16	20
3	16	20
4	16	20

5	18	20
Total	**84**	**100**

2.2 IOT : WIRELESS TECHNOLOGY, SECURITY& COMMUNICATION PROTOCOLS

	L	T	P
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RATIONALE:

The future of Wireless technology and security Protocol is in Internet of Things. Global connectivity can be achieved through computer networks. A diploma holder in IOT should therefore understand the function of networks and get exposure to different existing and upcoming communication technologies. Knowledge about hardware and software requirements of networks is essential to communicate and connect to wide world of IOT's.

LEARNING OUTCOME:

After undergoing the subject, the students will be able to know about signal types, transmission media know about different communication methodologies.

- Know about different communication methodologies .
- Setup computer networks
- Setup basic wireless network diagnose & solve network problems diagnose & solve network problems remotely.
- Provide security to networks manage & handle wan prevent external network attacks identify network troubleshooting methods.

DETAILED CONTENTS:

Unit 1: Overview of wireless communication, cellular communication, different generations and standards in cellular communication system, satellite communication including GPS, wireless local loop, cordless phone, paging systems, RFID. (8)

Unit 2: Recent wireless technologies: multicarrier modulation, OFDM, MIMO system, diversity multiplexing trade-off, MIMO-OFDM system, smart-antenna; beamforming and MIMO, cognitive radio, software defined radio, communication relays, spectrum sharing.

Unit 3: Multiple access techniques in wireless communication: contention-free multiple access schemes (FDMA TDMA, CDMA, SDMA and Hybrid), contention-based multiple access schemes (ALOHA and CSMA),WiMax.

Unit 4: Ad-hoc wireless networks: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks, energy constrained networks. MANET and WSN. Wireless system protocols : mobile network layer protocol (mobile IP, IPv6, dynamic host configuration protocol), mobile transport layer protocol (traditional TCP, classical TCP improvements), support for mobility (wireless application protocol).

Unit 5: TCP/IP Addressing Concept of physical and logical addressing IPV4 addresses – Address space, Notations Classful Addressing-Different IP address classes, Classes & Blocks, Net-id & Host-Id, Masks, Address depletion Classless Addressing – Address blocks, Masks Special IP Addresses Subnetting and Supernetting Loop back concept Network Address Translation IPV4 Header IPV6 Header Comparison between IPV4 and IPV6.

LIST OF PRACTICALS:

1. Recognition and use of various types of connectors RJ-45, RJ-11,BNC and SCST.
2. Making of cross cable and straight cable Install and configure a network interface card in a workstation.
3. Identify the IP address of a workstation and the class of the address and configure the IP Address on a workstation Managing user accounts in windows and LINUX Sharing of Hardware resources in the network.
4. Use of Netstat and its options.
5. Connectivity troubleshooting using PING, IPCONFIG, IFCONFIG Installation of Network Operating System(NOS) Visit to nearby industry for latest networking techniques Create a network of at least 6 computers.

INSTRUCTIONAL STRATEGY:

Students need exposure to various security systems and software available in some organisations, universities and engineering colleges. For this, visits may be organized for students. The teachers should also be exposed in this area. Some practical's can be conducted in the laboratory.

MEANS OF ASSESSMENT:

Assignments and quiz/class tests, mid-term and end-term written tests Actual laboratory and practical work exercises and viva-voce software installation, operation, development and viva-voce.

RECOMMENDED BOOKS & REFERENCES:

- Rethinking the Internet of Things: A Scalable Approach to Connecting Everything, by Francis daCosta, ISBN: 978-1-4302-5740-0, 2013.
- Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint) J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
- Iti Saha Misra, "Wireless Communication and Networks : 3G and Beyond", 2/e, McGraw Hill.
- Architecting the Internet of Things, by Dieter Uckelmann, Mark Harrison and Florian Michahelles, ISBN: 978-3-642-19157-2, 2011.
- Internet of Things: Privacy & Security in a Connected World, Federal Trade Comission, 2015.
- Security and the IOT ecosystem, KPMG International, 2015 .
- Internet of Things: IOT Governance, Privacy and Security Issues" by European Research Cluster.
- Computer Networks by Tanenbaum, Prentice Hall of India, New Delhi Data Communications and Networking by Forouzan, (Edition 2 nd and 4th), Tata McGraw Hill Education Pvt Ltd , New Delhi.
- Data and Computer Communication by William Stallings, Pearson Education, New Delhi
- Local Area Networks by Peter Hudson Network+ Lab manual,- BPB Publications -by Tami Evanson .
- Networking Essentials – BPB Publications New Delhi
- Computer Network and Communications By V.K. Jain and Narija Bajaj, Cyber Tech Publications, New Delhi.
- Cloud Computing Bible by BerrieSarinby.

Websites for Reference:

http://swayam.gov.in

SUGGESTED DISTRIBUTION OF TOTALS PERIODS & MARKS.

Unit No.	Total Periods	Marks %
1.	14	20
2.	16	20
3.	14	24
4.	20	20
5.	20	16
Total	**84**	**100**

2.3 IOT: USING RASPBERRY Pi

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RATIONALE:

The Internet of Things (IOT) is defined as the network of physical objects, things that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet

1- This program aims to train students to be equipped with a solid theoretical foundation, systematic professional knowledge and strong practical skills in the Raspberry Pi.
2- After doing this course, students should be able to design and deploy multiple IOT devices.
3- The students will get hands on experience in working with Raspberry Pi 3 and exploring IOT.
4- Developing Mobile App for IOT application

LEARNING OUTCOME: After completion of the course, the students will be able to understand the

1. working of Raspberry Pi, its features and how various components can be used with Pi.
2. The students will be able to understand IOT practically.
3. Familiar with Basic Concepts of Linux.
4. Familiar with basic foundations of Python Programming and libraries
5. Develop a Mobile App for IOT applications.

PREREQUISITES: Basic knowledge about Python & Basic electronics . Students must purchase a standard hardware kit consisting of a Raspberry Pi 3 Model B+ with power supply and several hardware sensor and control modules that are used during the course.

DETAILED CONTENTS:

Unit-1 Overview of IOT and Introduction to Raspberry Pi: Understanding IOT fundamentals, Various Platforms for IOT, Real time Examples of IOT, Overview of IOT components and IOT Communication Technologies. Introduction to Raspberry Pi, Comparison of various Rpi Models.

Unit-2 Getting Started with Raspberry Pi: Basic functionality of Raspberry Pi board, setting up the board, Pin Description of Raspberry Pi, On-board components of Rpi, configuration and its uses.

Unit-3 Booting Up RPi- Operating System and Linux Commands: Implications of an operating system on the behavior of the Raspberry Pi as an IOT device. Basics of Linux and its use, Linux Architecture, File System, Raspbian O.S.- Introduction, Tools like Leafpad Editor, Installing Raspbian on Pi, First boot and Basic Configuration of Pi, Popular Linux Commands.

Unit-4 Working with RPi using Python and Sensing Data: Basics of the Python programming language, programming on the Raspberry Pi. Python on Raspberry Pi, Python Programming Environment, Python Expressions, Strings, Functions, Lists, Control Flow. Sensors Interfacing- Temperature and Humidity Sensor (DHT11), Motion Sensor (PIR), Obstacle detection using Ultrasonic sensor, etc., Communicating using RPi- GSM interfacing, Accessing on-board Wi-Fi, Connecting Database with RPi

Unit-5 IOT Design using Raspberry Pi: IOT Applications based on Pi, Web server for IOT, Cloud for IOT, LAMP Web-   server, GPIO Control over Web Browser, Creating Custom Web Page for LAMP, Communicating data using on-board module, Home automation using Pi, Node-RED, MQTT Protocol, Using Node-RED Visual Editor on Rpi.

LIST OF PRACTICALS:

1.Raspberry Pi Installation & Configuration Process
2. Linux basic commands for Application Execution.
3. Controlling IOT LED Using Raspberry Pi and Python
4. How to use Python-based IDE (integrated development environments) for   the Raspberry Pi and how to trace and debug Python code on the device

5.Remote Login Methods

6. How to have your Raspberry Pi interact with online services through the use of public APIs and SDKs

7. Understanding the connectivity of Raspberry-Pi with IR sensor. (Write an application to detect obstacle and notify user using LEDs.)

8.Computer App Designing with Tkinter

INSTRUCTIONAL STRATEGY:

Some of the topics may be taught using question/answer, assignments, seminar, Quiz (on topics where the content can be compiled by smaller aspects and data (Individuals or groups as teams)) or case study method. The teacher will discuss case studies with students to assert the importance of the subject, since this subject is Practical oriented, the teacher should demonstrate the capabilities of Raspberry Pi to students while doing practical exercises. The students should be made familiar with developing **Computer App Designing** and understand the basic concept of Raspberry Pi for IOT applications.

MEANS OF ASSESSMENT:

Assignments and quiz/class tests, Efficient delivery using seminar presentations, mid-term and end-term written tests.

Actual laboratory and practical work exercises − Software installation, operation, development.

RECOMMENDED BOOKS & REFERENCES:

- Internet of Things: A Hands On Approach, University Press,VijayMadisetti, ArshdeepBahga.
- The Internet of Things: Connecting Objects to the Web,Wiley PublisherHakimaChaouchi.
- Raspberry Pi Cookbook: Software and Hardware Problems and Solutions by Simon Monk.
- Simon Monk, "Programming the Raspberry Pi: Getting Started with Python", January 2012, McGraw Hill Professional
- The official raspberry Pi Projects Book https://www.raspberrypi.org/magpiissues/Projects_Book_v1.pdf
- Eben Upton and Gareth Halfacree, "Raspberry Pi User Guide", August 2016, 4th edition, John Wiley & Sons
- Alex Bradbury and Ben Everard, "Learning Python with Raspberry Pi", Feb 2014, JohnWiley & Sons
- Michael Margolis, "Arduino Cookbook", First Edition, March 2011, O'Reilly Media,

Websites for Reference:

- http://www.spoken-tutorial.org
- http://swayam.gov.in

SUGGESTED DISTRIBUTION OF TOTAL PERIODS & MARKS :

Unit No.	Total Periods	Marks (%)
1.	16	19
2.	14	17
3.	17	20
4.	20	24
5.	17	20
Total	**84**	**100**

2.4. IOT PROJECT/SEMINAR

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LEARNING OUTCOMES

- After undergoing through this subject, the student will be able to handle IOT tools and multiple embedded devices and can control them. They can create own network of smart devices. They will be able to program Arduino and RASPBERRY PI for creating IOT projects.
- Able to Demonstrate skill and knowledge of current IOT tools and techniques.
- Develop leadership abilities and work with the team.
- project work aims at exposing the students to various industries dealing with this subjects. It is expected from them to get acquainted with controlling embedded electronic devices with external interface of sensors.
- In project activity, each student is supposed to prepare a detail project report of the project done by him/her. The students should be guided by the respective subject teachers. Teacher may guide groups of 4 to 5 students. The teacher & Examiner will conduct performance assessment of students.

Criteria for assessment will be as follows:

Internal Assessment

	Criteria	Weightage
(a)	Attendance and Punctuality	15%
(b)	Initiative in performing tasks/ knowledge about the project	40%
(c)	Synergy with the group members	15%
(d)	Report Writing	30%
	Total	100%

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External Assessment

	Criteria	Weightage
(a)	Project Report	30%
(b)	Execution of Project	40%
(c)	Viva on the project and related subject.	30%
	Total	100%

Student Centred Activities

The purpose of this subject is to enhance the skills of students in following areas:

1. Level of academic knowledge

2. Organizing quiz programs and debates .

3- Interview preparation

RESOURCE REQUIREMENT

Physical Resources

Space Requirement:

Norms and standards laid down by All India Council for Technical Education (AICTE) may be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

Laboratoires/Shops

EQUIPMENT LIST FOR P.G. DIPLOMA IN INTERNET OF THINGS (IOT)

Sr. No.	Description	Qty	Approx. Price(Rs)
	(A) PERMANENT ITEMS		
1.	Computer Desktop (i7,8th Generation, 1TB Hard disk, 8Gb RAM, Pre loaded window) or higher specification with furniture for each computer	25	20,00,000/-
2.	Switch with 32 port	1	20,000/-
3.	Multifunctional Laser Printer	1	30,000/-
4.	Online UPS, 6KVA	2	2,00,000/-
5.	Laptop	1	75,000/-
6.	LCD/DLP Projector with Screen	1	35,000/-
7.	Digital Board	1	50,000/-
8.	Air Conditioner 2 ton	2	1,00,000/-
	TOTAL		**25,10,000/-**
	(B) FITTING		
1.	Internet Connectivity	25 Nodes	1,25,000/-

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	TOTAL		1,25,000/-
	(C) OPEN SOURCE		
1.	Android Studio (Open Source)	-	-
2.	SciLab (Open Source)	-	-
3.	Microsoft Azure/AWS/EC2 (Open Source)	-	-
4.	Own Cloud (Open Source)	-	-
5.	CloudSim (Open Source)	-	-
6.	Raspbian OS (open source)	-	-
7.	Python(open source)	-	-
	TOTAL	-	-
	(D) CONSUMABLES		
1.	Antivirus Software	For 25 computers	25,000/-
2.	Arduino Uno IDE with built in Wifi	100	1,00,000/-
3.	Raspberry pi	50	2,00,000/-
4.	Sensor Kits (e.g. MQ135, DHT11 etc.)	50	2,50,000/-
5.	Bluetooth module HC05	50	20,000/-
6.	Display Screen	50	20,000/-

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7.	Relay Module	400	1,00,000/-
8.	Miscellaneous- cables and connectors, computer stationery, printer consumables etc.	LS	1,00,000/-
	TOTAL		**8,15,000/-**
	GRAND TOTAL(A+B+C+D)		**34,50,000/-**

Furniture Requirement

1.   Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

2.   Furniture for laboratories/Computer Centre   15 lacs

Human Resources

3.   Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE. The website www.aicte.ernet.in may be referred for downloading current norms and standards pertaining to technician courses.

EVALUATION STRATEGY

 INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavour is to ensure the quality of the product which can be accessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students. Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

11.2   STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work

A.   Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional /class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g., multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II: Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned

Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent
Higher than application i.e., Analysis, Synthesis and Evaluation	Up to 10 percent

B. Practical Work

Evaluation of student's performance in practical work (Laboratory experiments, Workshop practical's/field exercises) aims at assessing students' ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work-related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

C. Project

The purpose of evaluation of project work is to assess students' ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

ASPECTS OF QUESTION PAPER SETTING

Validity and reliability are the most important considerations in the selection and construction of evaluation procedures. First and foremost are the evaluation tools to measure the specific outcomes for which they are intended to measure. Next in importance is reliability, and following that is a host of practical features that can be classified under the heading of usability.

For weightage of marks assigned to formative (internal) and summative (external) evaluation and duration of evaluation has been given in the study and evaluation scheme of the curriculum document. Teachers/Paper-setters/Examiners may use Manual for Students' Evaluation developed by Institute of Research Development & Training, U.P. Kanpur to bring objectivity in the

evaluation system. The working group found it very difficult to detail out precisely the contents of subject on languages and therefore teachers may send guidelines to respective examiners for paper setting to maintain objectivity in evaluation.

RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

This curriculum document is a Plan of Action (POA) and has been prepared based on exhaustive exercise of curriculum planning and design. The representative sample comprising selected senior personnel (lecturers and HODs) from various institutions and experts from industry/field have been involved in curriculum design process.

The document so prepared is now ready for its implementation. It is the faculty of polytechnics who have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that a proper mix of different teaching methods in all these places of instruction only can bring the changes in stipulated students' behaviour as in the curriculum document. It is important for the teachers to understand curriculum document holistically and further be aware of intricacies of teaching-learning process (T-L) for achieving curriculum objectives. Given below are certain suggestions which may help the teachers in planning and designing learning experiences effectively. These are indicative in nature and teachers using their creativity can further develop/refine them. The designers of the programme suggest every course teacher to read them carefully, comprehend and start using them.

(A)   Broad Suggestions:

1.   Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale and philosophy.

2.   Uttar Pradesh State Board of Technical Education (BTE U.P.) may make the academic plan available to all polytechnics well in advance. The principals have a great role to play in its dissemination and, percolation up to grass-root level. Polytechnics in turn are supposed to prepare institutional academic plan by referring state level BTE plan.

3.   HOD of every Programme Department along with HODs and in-charges of other departments are required to prepare academic plan at department level referring institutional academic plan.

4.   All lecturers/Senior lecturers are required to prepare course level and class level lesson plans referring departmental academic plan.

(B)   Course Level Suggestions

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practical's, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of 16 weeks which is made available to them in the academic plan at BTE level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process   effectively:

1.   Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available, course to be taught, different learning experiences required to be developed etc.

2.   Teachers are required to prepare lesson plan for every theory class. This plan may comprise of content to be covered, learning material (transparencies, VCDs, Models etc.) for execution of a lesson plan. They may follow steps for preparing lesson plan e.g., drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcome and reinforce learning etc.

3.   Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.

4.   Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The tutorial, assignment and seminar can be thought of as terminal outcome of library experiences.

5.   Concept and content-based field visits with appropriate releases (day-block) may be planned and executed for such content of course which otherwise is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem-based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.

7. Planning of progressive assessment encompasses periodical assessment in semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive explicit feedback to every student. It has to be planned properly; otherwise, very purpose of the same is lost.

8. The co-curricular activities like camp, social gathering, study tour, hobby club etc. may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.

9. Where ever possible, it is essential to use activity-based learning rather than relying on delivery based conventional teaching all the time.

10. While imparting instructions, emphasis may be laid on the development of cognitive, psychomotor, reactive and interactive skills in the students.

11. Teachers may take working drawings from the industry/field and provide practices in reading these drawings.

12. Considerable emphasis should be laid in discipline specific contracting and repair and maintenance of machines, tools and installations.

13. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.

14. Case studies and assignments may be given to students for understanding of Enterprise Resource Management (ERM).

15. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

16. Students may be given relevant and well thought out minor and major project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment (wage and self).

17. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, Research Institutes and other relevant field organizations in the state.

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