

NEP-2020 Aligned Curriculum for

Three Year (Six Semester) Diploma Programme in

COMMUNICATION AND COMPUTER NETWORKING

For the State of Uttar Pradesh



Prepared by:

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FIFTH SEMESTER

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SIXTH SEMESTER

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PREFACE

An important issue generally debated amongst the planners and educator'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 the shrinking of the world, bringing people from different culture and environments 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. 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 Technical Education, UP to revise the existing curricula of diploma programmes as per the needs of the industry and making them NEP-2020 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 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 of 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

Director

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Coordinator

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1. SALIENT FEATURES

- 1) Name of the Programme : Diploma Programme in Communication and Computer Networking
- 2) Duration of the Programme : Three years (Six Semesters)
- 3) Entry Qualification : As Prescribed by State Board of Technical Education, UP
- 4) Intake : As prescribed by the Board)
- 5) Pattern of the Programme : Semester Pattern
- 6) Ratio between theory and Practice : 40 : 60 (Approx.)

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN COMMUNICATION AND COMPUTER NETWORKING

Diploma holders in Communication and Computer Networking can find employment in following divisions:

- (1) Service Division (IT enabled services, maintenance service and installation of computer services)
- (2) Assembly and Quality Control Division
- (3) Software Development and Testing Industries
- (4) Web Development Industries
- (5) Mobile Applications Development
- (6) Junior Level Data Analytics
- (7) Industry Automation
- (8) E-Commerce Support Engineer
- (9) News and Newspaper/Agencies, Magazines
- (10) Data Entry and MIS/ERP Operator
- (11) Lab. Assistant/Technician
- (12) Hospitals/Healthcare/Institutions/Schools
- (13) Cloud Services Support Engineer
- (14) Publishing Industry
- (15) Animation Industry
- (16) Data Processing Industry
- (17) Marketing Division(Corporate Handling, SME, Institutional Segment, Government Tender Business)
- (18) Telecommunication Sector
- (19) Teaching Organizations (Polytechnics, Vocational Institutions etc)
- (20) Networking(LAN, WAN etc)
- (21) Defence Services/Police Services/Cyber Services/Forensic Services
- (22) Tele-Communication Engineering and related Departments
- (23) AIR, Doordarshan
- (24) Radar and Wireless domain
- (25) Defence Services, Para-military Forces

- (26) Civil Aviation
- (27) Electricity Boards and Corporations etc.
- (28) PCB Design and Fabrication Industry
- (29) Consumer Electronics Industry
- (30) Electronic Components and Devices Manufacturing and Installation Organizations
- (31) Computer Assembling and Computer Peripheral Industry;
- (32) Instrumentation and Control Industries
- (33) Internet Server Providers
- (34) Mobile Phone assembly Industries

While in employment, the following areas of activity in different organizations (industry and service sector) are visualized for diploma holders in Communication and Computer Networking

- Assembly and installation of computer systems, peripherals and software
- Programming customer based applications including web page designing
- Testing and maintenance of computer systems
- Marketing of software and hardware
- Teaching and training at educational institutions
- Self-employment – call centres, BPO, EPO etc.
- Network installation and maintenance
- Cyber Cafés
- Marketing and Sales (Distributors - whole sale and retailers)
- Service Sector(repair and Maintenance; job work)
- Cable laying and jointing DBs etc.
- Preparing Simulated Models

Various Designations for Diploma Holders in Communication and Computer Networking

- (1) Service engineer/customer support engineer/maintenance engineer in installation, maintenance and service of computer systems and networking
- (2) Assembly supervisor in manufacturing and production activity
- (3) Data entry operator, computer operator, DTP operator, technician
- (4) Technical Assistant/junior engineer in quality control and testing activities of computer systems manufacturing
- (5) Junior marketing executive/junior sales executive/sales engineer in marketing activities

- (6) Junior/senior technical assistant in R&D laboratories and educational institutions to help in maintaining computers and networks
- (1) Test engineers in process industry

3.STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN COMMUNICATION AND COMPUTER NETWORKING

FIFTH SEMESTER

Sr. No.	SUBJECTS	Course Type	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External	Evaluation Type
			Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
5.1	Industrial Training (Summer Internship-II)	Internship	-	-	-	2	-	60	60	-	-	40	3	40	100	-
5.2	Digital Communication	Theory	3	0	0	3	40	-	40	60	3	-	-	60	100	Theory
5.3	Advance Computer Networking	Practicum	1	0	5	3	-	60	60	-	-	40	3	40	100	Practical
5.4	Cloud Computing	Practicum	2	0	5	4	-	60	60	-	-	40	3	40	100	Practical
5.5	Program Elective-1 - Wireless Communication and Standards - Cyber Security , IT laws & Forensics	Theory	3	0	0	3	40	-	40	60	3	-	-	60	100	Theory
5.6	Program Elective-2 - Cellular Communication and Mobile Computing Platform - Internet of Things	Practicum	1	0	5	3	-	60	60	-	-	40	3	40	100	Practical
5.7	Open Elective-III ^	Open Elective	2	0	0	2	50	-	50	-	-	-	-	-	-	Qualifying
	Advance Skill Development		-	-	-		-	-	-	-	-	-	-	-	Certification	
5.8	*Indian Constitution (Q)	Audit	2	-	-	-	50	-	50	-	-	-	-	-	-	Qualifying
#Student Centred Activities (SCA)		-	-	-	7	-		50	50	-	-	-	-	-	50	-
Total		-	14	-	22	20	80	290	370	120	-	160	-	280	650	-

- Common with other diploma course.
Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

List of Subjects for Open Elective-III (Any One)

SR. NO.	SUBJECT NAME
1	Mechatronics
2	Engineering Economics & Accountancy
3	Any Course Of Minimum 02 Credit From (Advance Skill Development) • NPTEL • MOOCS THROUGH SWAYAM • AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES • C-DAC • CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.) • ISRO E-LEARNING • COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION.

Advance Skill Development:

To fulfill the requirements for Advanced Skill Development, a minimum of 20 hours of skill certification is necessary. This certification must be obtained from a recognized national or international agency or institute. The assessment and certification process will be conducted by the respective agency or institute. Students must present their certificate to earn 02 credits for this subject.

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN COMMUNICATION AND COMPUTER NETWORKING
SIXTH SEMESTER

A: Normal Pathway

Sr. No.	SUBJECTS	Course Type	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External	Evaluation Type
			Periods/ Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT								
			L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot				
6.1	Entrepreneurship & Start ups*		2	-	-	2	40	-	40	60	3	-	-	60	100	Theory		
6.1	Electives-3 (Pathway) • 5G Technology • Project Management	Theory	3	0	0	3	40	-	40	60	3	-	-	60	100	Theory		
6.2	Elective-4 (Specialization) • Mobile Application Development • E-commerce & Digital Marketing • Data Science	Practicum	1	0	4	3	-	60	60	-	-	40	3	40	100	Practical		
6.3	Project	Practical	-	-	24	12	-	240	240	-	-	160	3	160	400	Practical		
#Student Centred Activities (SCA)			-	-	2	-		50	50	-	-	-	-	-	50	-		
Total			6		30	20	80	350	430	120	-	200	-	320	750			

* Common with other Engineering diploma Programmes

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

STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN COMMUNICATION AND COMPUTER NETWORKING
SIXTH SEMESTER

B: Internship Pathway

Sr. No.	SUBJECTS	STUDY SCHEME			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External	Exam Type
		Periods/Week				INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
		L	T	P		Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
6.1	*Entrepreneurship And Start-Up (Online Mode)	-	-	-	2	-	-	-	100	3	-	-	100	100	Theory	
6.2	Industry Hands on Practice	-	-	-	4	-	-	-	-	-	-	-	-	350	-	
	Industrial Project	-	-	-	12	-	-	-	-	-	-	-	-	200	-	
	Seminar (In Institute)	-	-	-	2	-	100	100	-	-	-	-	-	100	Seminar	
Total		-	-	-	20	-	100	100	100	-	-	-	100	750	-	

* Common with another diploma programme

NOTE:

1. The Industrial training tenure should not be less than 4 months.
2. Industry must be registered with MSME / Directorate of industries/Limited Organization/ State/Central Government establishments.
3. Monthly progress reports of Intern/ Trainee should be attested and forwarded by industrial supervisor (allotted to Intern/Trainee) during industrial Internship/Training.
4. The Industrial unit/organisation must evaluate students using the format provided by polytechnic in the form of marks.
5. The Industrial Hands on Practice, Industrial Project and seminar must be evaluated on the basis of the BTE Internship / Training Policy - 2025.
6. "Entrepreneurship and Start-up" course is also mandatory in Industrial internship/training mode. It will be conducted online mode by his/her polytechnic institute. After completing the online course, students must appear for exam conducted by the Board of Technical Education, Lucknow.

4. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 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. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 8 Marks
 - b) 80 - 85% 9 Marks
 - c) Above 85% 10 Marks
- iii. 30 Marks maximum for Sports/ NCC/ Cultural/ Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 30 - State/National Level participation
 - b) 25 - Participation in two of above activities
 - c) 15 - Inter-Polytechnic level participation

5.1 INDUSTRIAL TRAINING

(Summer Internship-II)

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organised during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

a) Punctuality and regularity	15%
b) Initiative in learning new things	15%
c) Presentation and VIVA	15%
d) Industrial training report	55%

5.2	DIGITAL COMMUNICATION	L	T	P	C
THEORY		3	0	0	3

Introduction:

This subject introduces students to the fundamental concepts and techniques for digital communication principles. This course fulfils the need for students to have a thorough knowledge of digital modulation, error control coding and spread spectrum communication techniques.

Course Objectives:

The objective of this course is to enable the students

- to To know the Basics of Digital Communication
- To study about the various types of signals
- To understand the sampling process and Spread spectrum communication
- To understand the pulse digital modulation methods
- To learn about types of coding methods
- To study about various error control codes
- To learn the Digital modulation techniques

Course Outcomes:

On successful completion of this course, the student will be able to

- C01: Understand the basics of digital communication
- C02: Understand the Various pulse digital modulation techniques and line coding
- C03: Understand the various digital modulation schemes.
- C04: Analyze the error detection and correction methods.
- C05: Understand the spread spectrum communication techniques.

	DIGITAL COMMUNICATION	L	T	P	C
Theory		3	-	-	3
Unit I	BASICS OF DIGITAL COMMUNICATION				
Introduction of signal and classification, Block diagram of digital communication system. Merits/demerits and Comparison of analog and digital communications. Base band and pass band transmission. Information capacity, entropy, bit-rate, baud rate and bandwidth of digital data , Sampling: sampling process, and sample and hold circuit, Types of sampling, Sampling theorems, Nyquist criterion and aliasing effect.					10
Unit II	PULSE DIGITAL MODULATION TECHNIQUES				
Quantization: Definition, process and classification, Quantization noise, Pulse-code modulation system, DPCM, Delta modulation system and adaptive delta modulation, Comparison of different pulse modulation methods. Line coding and types: unipolar RZ and NRZ, Polar RZ and NRZ, bipolar NRZ, split phase Manchester format.					8
Unit III	DIGITAL MODULATION TECHNIQUES				
Generation and detection of Binary ASK, FSK, PSK, QPSK(Coherent only), DPSK, Minimum Shift Keying (MSK) and GMSK. Advantages/Disadvantages and applications of different digital modulation techniques. Comparison of different modulation techniques.					9
Unit IV	ERROR CONTROL CODING				
Types of codes, Discrete memory less channel ,Error control coding methods ,forward error correction , error detection with retransmission ,types of errors :random error and burst error, Principles of linear block codes, Hamming code, Binary cyclic codes, Cyclic redundancy check code (CRC),Convolution code.					9
Unit V	SPREAD SPECTRUM TECHNIQUES				
Spread spectrum communication, Pseudo noise sequences, Properties of PN sequence: Balance property, Run property and Correlation property, Direct sequence spread spectrum systems ,Processing gain and performance, Frequency hopping systems ,Comparison of fast hopping versus slow hopping ,Synchronization, Jamming consideration, Commercial application of spread spectrum communication.					9
TOTAL PERIODS					45

Suggested List of Students Activity:

- Presentation / Seminars by students on any recent technological developments based on the course.
- Periodic class /online quizzes conducted based on the course.
- Blended learning activities to explore the recent trends and developments in the field.
- Visit nearby BSNL and TV station and prepare detail report of digital communication.
- Student may view video lectures from NPTEL on Digital communication systems and submit assignments on required topics.

Text Books for Reference:

1. Simon Haykin ,Digital Communication Systems, 1st edition , John Wiley & Sons Inc, 2013
2. Wayne Tomasi ,Electronic communication systems, 5th Edition ,Pearson Education,2008
3. T. L. Singal,Analog and Digital Communications, 1st Edition, Mc Graw Hill Education Pvt. Ltd,2012

Web-based/Online Resources:

1. <https://nptel.ac.in/courses/117101051>
2. https://onlinecourses.nptel.ac.in/noc22_ee10/preview

5.3	ADVANCE COMPUTER NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

The course is designed for students with basic knowledge of networking and involves both theory and practical sections. This course is designed to introduce the fundamentals of some advanced networking concepts, like routing protocols, wireless networks etc. This course provides students with an opportunity to learn the fundamentals behind the design of wireless sensor networks. Students will also learn to use network simulators to design various network scenarios.

Course Objectives

The objective of this course is to enable the student

- To gain knowledge in rapidly growing technologies in networks.
- To learn to develop solutions involving campus network topology design, switching, routing, internet connectivity.
- To get familiar with wireless sensor network and its applications.
- To simulate various network topologies in software.
- To demonstrate practical skills acquired through laboratories sessions either individually or as a group.

Course Outcomes

After successful completion of this course, the students should be able to

C01: Demonstrate an appreciation of theory and practice of wireless LAN.

C02: Demonstrate ability to setup and administer a network with both wired and wireless devices.

C03: Simulate working of wired and wireless networks and illustrate understanding of networking concepts.

C04: Describe the overview of wireless sensor networks and enabling technologies for WSN.

C05: Apply the design principles of WSN architectures and implement LEACH protocol by simulating environment situations.

	ADVANCE COMPUTER NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3
Unit I	INTRODUCTION TO WIRELESS LAN				
ISM band, 802.11a/b/g wireless standards - Adhoc, infrastructure mode of WLAN - Access Point in Repeater Mode - Security in WLAN, MAC Filtering, WEP/WPA - Evaluation of WLAN, Wireless Home Networking - IEEE 802.11 standard for WLAN					4
Ex No 1: Study the interfaces in a router. (Console port, AUI, Serial, Auxiliary, Ethernet, Fast Ethernet, BRI). Setup up a Wi-Fi router in your lab, log in and configure the router. Connect a PC in your lab to Wi-Fi. Ex No 2: a) Wireless LAN setup in infrastructure mode - Configure a Wi-Fi router in one floor of your institution, use wireless access points to extend Wi-Fi to other floors in your organization b) Wireless LAN setup in adhoc mode - Create a ADHOC network in a windows device, add other windows devices to this ADHOC network and ensure connection through ping command.					12
Unit II	ROUTING BASICS				
IP Routing: Static Routing - Dynamic Routing - Basic Routing Protocols					3
Ex No 3: Create two subnets, configure a Wi-Fi router to connect these subnets (have wired and wireless devices in the subnets). Add static routes as required and use ping command to ensure the connectivity between these subnets. Ex No 4: Telnet into the router and perform basic router commands to get stats of the devices connected to your router. Ex No 5: Download and install a network simulator.					18
Unit III	APPLICATION LAYER PROTOCOLS				
DNS - Concept of Domain name space, DNS operation. DHCP - Static and Dynamic Allocation, DHCP operation. Remote Login: TELNET					4

Ex No 6: Create a topology with one server and few client computers, use DHCP and show dynamic IP allocation using relevant simulation software.		18
Ex No 7: Configure Domain Name Server (DNS) using relevant simulation software.		
Ex No 8: Configure Telnet Server in a windows machine and access it by using a client connected in intranet.		
UNIT IV	OVERVIEW OF WIRELESS SENSOR NETWORK	
Single-Node Architecture - Hardware Components- Network Characteristics- Types of wireless sensor networks - Introduction to IEEE 802.15.4 standard and ZigBee – Overview of Routing protocols in WSN – LEACH protocol		4
Ex No 9: Simulate a wireless sensor network.		12
Ex No 10: Implementation of LEACH routing protocol in simulation.		
TOTAL HOURS		75

Suggested List of Students Activity

- Presentation/Seminars by students on emerging technological developments in wireless networks can be encouraged.
- Periodic class/online quizzes conducted based on the course.
- Blended learning activities to explore the recent trends and developments in the field.

Textbook for Reference

- Andrew S. Tenenbaum, Computer Networks, 5th Edition, Pearson Publication, 2011.
- William Stallings, Wireless Communications and Networks, 2nd Edition, Pearson Education Inc, 2005.
- C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, 2nd Edition, Pearson Publication, 2015.

Web-based/Online Resources

- CISCO – Routing protocols: <https://www.cisconetsolutions.com/introduction-to-routing-protocols/>
- Blog about NS2 simulator:
<https://ns2blogger.blogspot.com/p/ns2-program-for-wireless-topology.html>

Equipment / Facilities required to conduct the Practical Portion

1. Hardware Requirement:

- Desktop Computers with wireless network adapter
- Wi-Fi Router ,Wireless Access Points (WAP)
- Wireless devices like Laptop, Smartphone, Printer

2. Software Requirement:

- Network simulation software – like CISCO packet tracker/NS2

5.4	CLOUD COMPUTING	L	T	P	C
PRACTICUM		2	0	4	4

Introduction

This course will introduce the emerging technology cloud computing. The advantages of cloud services and cloud applications will give the students the much needed exposure to the current trend.

Course Objectives

The objective of this course is to

1. Introduce the concept of virtualization.
2. Outline the concepts of cloud computing.
3. Summarize the different types of web services and cloud service providers.
4. Elaborate the security issues in cloud.
5. Present the cloud applications.

Course Outcomes

After successful completion of this course, the students should be able

to CO1: Understand the concept of virtualization.

CO2: Differentiate various cloud services.

CO3: Explore the different cloud service providers.

CO4: Understand the security issues with cloud and security policies. CO5: Comprehend the various cloud applications.

	CLOUD COMPUTING	L	T	P	C
PRACTICUM		2	0	4	4
Unit - 1	CLOUD COMPUTING				
Characteristics of Cloud - Benefits – limitations - Cloud Deployment Models - Cloud service models - Infrastructure as a service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS), Anything as a Service(XaaS) – SPI Vs Traditional IT Models – Cloud Data Centers.					6
Ex.No.	Name of the Experiment				

1	Schedule an online meeting with Google Meet through Google Calendar.	12
2	Use Google Drive as Storage as a Service to Store, Organize, Share and Collaborate.	
Unit - 2	VIRTUALIZATION	
Virtualization, Hypervisors, Types of hypervisors. Virtualization techniques - para virtualization - full virtualization, - hardware assisted virtualization - hybrid virtualization, what is virtual machine, server virtualization models, server virtualization platforms Architecture.		6
Ex.No.	Name of the Experiment	
3	Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of existing OS.	12
4	Setting up a Java development Virtual Machine with VirtualBox.	
Unit - 3	WEB SERVICES AND CLOUD SERVICE PROVIDERS	
Web Services and its types, Google compute engine, Google App Engine, Amazon - Amazon Elastic Compute Cloud - Amazon Simple DB - Amazon Simple Storage Service (S3) - Amazon Cloud Front.		6
Ex. No.	Name of the Experiment	
5	Install a PaaS Engine (Google App Engine / AWS / Azure or any one PaaS Engine) and create simple web applications using python/java.	12
6	Install OpenStack on your workstation and launch the first instance.	
Unit - 4	SECURITY IN THE CLOUD	
Storage Location and Tenancy - Cloud Security Challenges - CSA Reference Model - Security Policies and Implementation – Virtualization Security Management.		6
Ex. No.	Name of the Experiment	
7	Install Docker Engine on Linux / Windows.	12
8	Protect Google Sheets and Range with various access permissions.	
Unit - 5	CLOUD COMPUTING APPLICATIONS	
Adobe Creative Cloud Firefly design models– GitHub repository basics– LinkedIn Benefits– Zoho WorkDrive Features – Storage Concept of Google Bigtable.		6
Ex. No.	Name of the Experiment	
9	Setup a github account and develop a simple python project.	

10	Create a column family with an age-based garbage-collection policy in Google Bigtable.	12
TOTAL HOURS		90

Suggested List of Students Activity

- Presentation/Seminars by students on any recent technological developments based on the course
- Micro project that shall be an extension of any practical lab exercise to real-world application

Textbook for Reference:

- Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, First Edition, Tata Mcgraw Hill, 2013.
- George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, First Edition, O'Reilly, 2009.
- Ashish Bhatnagar, Shailza Sharma, Cloud Computing, First Edition, S.K. Kataria & Sons, 2019.

Website links for reference:

- <https://www.virtualbox.org/>
- <https://colab.research.google.com/>
- <https://cloud.google.com/appengine/>
- <http://www.seanmcilvenna.com/2018/03/26/setting-up-a-java-development-vm-with-virtualbox/>
- <https://cloud.google.com/bigtable/docs/samples/bigtable-create-family-gc-max-age>
- <https://www.accenture.com/gb-en/case-studies/about/cloud-security>
- <https://www.zoho.com/workdrive/features.html>

Facilities & Equipment required for the conduct of practicals

Hardware Requirement

Desktop computers with internet connection
Printer

Software Requirement

Windows / Linux operating System

5.5 PROGRAM ELECTIVE- 1

5.5.1	Wireless Communication and Standards	L	T	P	C
THEORY		3	0	0	3

Introduction:

In this world of connectivity and collaborative work environment, it is necessary to connect to the network from anywhere, with anybody, at any time. Wireless communication provides connectivity with mobility, flexibility and convenience. Wireless devices are used across the various industries like Healthcare, Education, Automation, Renewable energy sector, Automobile etc. Effective use of social networking has become possible due to high end wireless devices. This course will help the students to develop skills to handle wireless and mobile communication systems such as 2G/3G/4G/5G.

Course Objectives:

- To understand the basics of wireless communication
- To create the foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design
- To understand various multiple access techniques
- To know about wireless systems.
- To learn the fundamental and emerging trends in Mobile Communication, wireless Network/protocol architecture and broadcast systems.

Course Outcomes:

On successful completion of this course, the student will be able to :

C01: Describe the mobile and wireless network systems such as 2G/3G/4G/5G and its evolution.

C02: Explain cellular concepts like frequency reuse, hand-off and Interference

C03: Differentiate between multiple access schemes and concept of Spread Spectrum techniques

C04: Understand the architecture of wireless systems such as GSM, UMTS, IMT-2000.

C05: Compare the different wireless standards

	WIRELESS COMMUNICATION AND STANDARDS	L	T	P	C
THEORY		3	0	0	3
Unit I	INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS				
Evolution of mobile radio communications, examples of wireless communication systems- paging systems, cordless telephone systems, cellular telephone systems, comparison of common wireless communication systems, trends in cellular radio and personal communications. Modern Wireless Communication Systems: 2G,3G,4G,5G wireless networks.					9
Unit II	CELLULAR CONCEPT				
Introduction, Cell, Cell structure, Cluster, Frequency reuse, Channel Assignment strategies- Fixed and Dynamic assignment, Hand off Strategies-Concept of hand off, Types of hand off- Soft, Hard, MAHO(Mobile Assisted Handoff), Interference and system capacity-Cochannel Interference, Adjacent Channel Interference, Improving coverage and capacity in cellular systems- Cell splitting, Sectoring, Microcell Zone Concept.					9
Unit III	MULTIPLE ACCESS TECHNIQUES FOR WIRELESS COMMUNICATION				
Introduction to Multiple Access Techniques –Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA)-Distinction between TDMA FDD and TDMA TDD, Spread spectrum multiple access-Frequency Hopped Multiple Access (FHMA), Code Division Multiple Access (CDMA), Space Division Multiple Access.					9
Unit IV	WIRELESS SYSTEMS				
Global System for Mobile Communication - Features and Services- GSM architecture, GSM entities, Need for 3G ,4G and 5G technology, IMT 2000 Global standards-Vision- Compatibility, service and spectrum requirements, UMTS features and architecture.					9
Unit V	WIRELESS STANDARDS				
IEEE 802 Architecture - WiFi-IEEE 802.11a/g(OFDM)-IEEE 802.11b(DSSS), IEEE 802.15(WPAN), Wireless Metropolitan Area Network (WMAN) - Wi-MAX-IEEE 802.16- 4G LTE-LTE Advanced - 5G and advances.					9
TOTAL PERIODS					45

Suggested List of Students Activity:

- Visit nearby MTNL/BSNL exchange and prepare detail report of entire setup of their

cellular systems.

- Visit nearby CDMA based cellular switching centre and prepare details of the entire setup of their cellular system.
- Prepare a report on TRAI regulations related to mobile communications (spectrum allocation)
- Compare specifications/features/technology of different mobile phones available in market (Minimum 12 specifications)
- Prepare a brief report on how radiations from BTS and handsets affect human beings.

Text Book for reference:

- 1) Theodore S. Rappaport, "Wireless Communications, Principles and Practice", 2nd edition, Pearson Publication New Delhi, 2014.
- 2) Stallings W., "Wireless Communications & Networks", 2nd edition, Prentice Hall, 2009.
- 3) Lee, C.Y. William, "Mobile Cellular Telecommunication Systems", 2nd edition, McGraw Hill Education, New Delhi, 2017.

Website links for reference:

- <https://archive.nptel.ac.in/courses/117/102/117102062/>
- <https://www.digimat.in/nptel/courses/video/106106167/L01.html>

5.5.2	CYBER SECURITY, IT laws & Forensics	L	T	P	C
THEORY		3	0	0	3

Introduction

This subject will be responsible for establishing a comprehensive understanding in the field of cyber security. The students would be able to go deeper into hard-core cyber security topics during the course duration. The students know about the various ways to defend internet-connected devices and services from malicious attacks by hackers, spammers and cybercriminals.

Course Objectives

The objective of this course is to enable the student to

- Understand the basic concepts of cyber security.
- Learn about security attacks.
- Able to understand various modes of Cyber Crimes and Preventive measures.
- To understand the Cyber Legal laws and Punishments.
- Learn about approaches to secure networks, firewalls, and intrusion detection and prevention systems.

Course Outcomes

On successful completion of this course, the student will be able to

C01: Outline the basics of cyber security, security principles and models.

C02: Develop a deeper understanding and comprehend different types of cyber- attacks.

C03: Have an overview of the cybercrime and identify the need for cyber laws on cybercrime.

C04: Realize about tools and methods used in cybercrime.

C05: Employ intrusion detection and prevention tools and explore the Next Generation Security.

	CYBER SECURITY, IT laws & Forensics	L	T	P	C
THEORY		3	0	0	3
Unit I	Introduction to Cyber Security				
Cyber Security: Definition - Need for cyber security – Evolution of Cyber Security - Issues and challenges - Cyber Security Architecture and Components - Fundamental security principles: threats, attacks and vulnerability - Cyber security models (the CIA triad, the star model, the Parkerianhexad).					9
Unit II	Cyber Attacks				
Introduction - Scope of Cyber Attacks - Ransomware - Password Cracking- Keyloggers and Spywares - Virus and Worms - Trojan Horse - Steganography - DoS and DDoS Attacks - SQL injection - Phishing – Identity Theft (ID Theft): Types and Techniques.					9
Unit III	Cyber Crime and IT Act.				
Cyber Crime - Reason for Cyber Crime – History of Cyber Crime - Classification of Cybercrimes – Cybercriminals - Organisations dealing with Cyber Crime and Cyber security in India - Cyber Laws – The Indian IT Act, 2000 – Cybercrime and Punishment.					9
UNIT IV	Reconnaissance And Scanning				
Reconnaissance and types – Footprinting Tools: Harvester – Whois – Netcraft; Footprinting with DNS – Google Hacking - Social Engineering Reconnaissance; Scanning: Concept – Identify Active machines - Port Scanning – Scanning Methods: Ping sweeps – Nmap – XMAS.					9
UNIT V	Intrusion Detection and Prevention Systems				
Intrusion Detection System(IDS): Overview and Classification of IDS - Network-Based IDSs - Host-Based IDSs; Intrusion Prevention Systems: Introduction - Honeypots and Honeynets; Firewalls: Need for Firewalls - Types of Firewalls – IDS vs Firewalls.					9
TOTAL HOURS					45

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class/online quizzes on a weekly/fortnightly based on the course.
- Blended learning activities to explore the recent trends and developments in the field.
- Case study on recent cybercrime cases registered in India and their punishments.
- Group Discussion on cyber security tools among the students.
- Demonstration of installation and working of the cyber security tools.

Textbooks for Reference:

2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", First Edition, Wiley Publishers, 2011.
3. Lawrence C. Miller, "Cyber security for Dummies" -Palo Alto Networks, Seventh Edition, John Wiley & Sons, Inc., 2022.
4. William Stallings, "Effective Cyber security: A Guide to Using Best Practices and Standards", First Edition, Addison - Wesley Professional Publishers, 2018.

Web-based/Online Resources

- <https://nptel.ac.in>
- <http://swayam.gov.in>

5.6 PROGRAM ELECTIVE- II

5.6.1	CELLULAR COMMUNICATION AND MOBILE COMPUTING PLATFORM	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

This course introduces computer engineering students to the fundamental principles, theories, and practical aspects of mobile computing. Through a combination of theoretical lectures and hands-on practical exercises, students will gain a comprehensive understanding of mobile computing concepts and technologies.

Course Objectives:

- To learn the basics of wireless communication and cellular networks.
- To study the popular cellular networking technologies.
- To explore various protocols that support mobility at network layer and transport layer. The students should be able to simulate various network topologies with different routing algorithms and they can analyze how each routing algorithm is performing its job.

Course Outcomes:

On successful completion of this course, the student will be able to

- C01: To explore various modulation techniques, multiplexing techniques and familiarize with wireless LAN technologies including IEEE 802.11, HIPERLAN, and Bluetooth.
- C02: To understand the evolution and concepts of cellular communication explore the practical issues of mobile computing using network simulation tools.
- C03: To analyse and compare different ad hoc routing protocols.
- C04: To identify the limitations of traditional TCP and understand various TCP improvements and their benefits.
- C05: To understand mobile computing platforms and explore network simulators and programming platforms for mobile applications.

	CELLULAR COMMUNICATION AND MOBILE COMPUTING PLATFORM	L	T	P	C
Practicum		1	0	4	3
UNIT I CELLULAR COMMUNICATION					
Cellular Communication – Tessellation, Frequency Reuse and Handoff – Evolution of cellular communication systems: 1G, 2G, 3G, 4G and 5G. Overview of GSM - GPRS Network - UMTS and IMT 2000 - Packet Switching Domain - Core Network - Radio Access Network - LTE - Control Plane - User Plane.					5
Practical Exercises * 1. Installation of Network Simulator (Eg.NS2) 2. Implementation of Bluetooth network (transfer a file from one device to another). 3. Simulate authentication and encryption techniques used in GSM and analyze their performance. 4. Illustration of Hidden Terminal Problem using Network Simulator.					14
UNIT II MOBILE NETWORK AND TRANSPORT LAYER					
Mobile IP - Mobility features in IPv6 - Proactive and reactive adhoc routing protocols-DSDV, DSR. TCP improvements for Wireless Networks –Indirect TCP, Snoop TCP, Mobile TCP – Fast Retransmit/ Fast Recovery – Transmission/ Timeout Freezing – Selective Retransmission – Transaction Oriented TCP.					5
Practical Exercises * 5. Simulate the Distance Vector Routing Algorithm and Analyze the performance metrics such as throughput, packet drop rate etc. 6. Create a mobile chatting application using TCP with a mobile client.					08
UNIT III MOBILE COMPUTING PLATFORM					
PDA - Device characteristics and Software components - Smart Phone - Convergence of Mobile devices - Network simulators: NS2 – GLOMOSIM – SENSIM – OPNET – Programming Platforms – J2ME – Palm OS - SYMBIAN OS - Overview of other mobile Operating Systems.					5

Practical Exercises * 7. Set up a simple mobile network topology using a network simulator. Configure and manage mobile devices within a simulated network environment. 8. Setup & configure Wireless Access Point (AP) using Network Simulator. Analyze the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS).	08
TOTAL HOURS	45

Suggested List of Students Activity:

- Group activities challenging Network configuration.
- Performing a survey of popular mobile phones and exploring their configuration and exploring the structure and operation of a cell phone tower.
- Activities, like contest, to develop Mobile application using Network Simulator.

Text Books for Reference:

1. J. Schiller, "Mobile Communication", Pearson Education, 2009.
2. K. Ashoke Talukder, Roopa Yavagal, "Mobile Computing", Tata McGraw Hill, 2005
3. Paul Bedell, "Cellular networks: Design and Operation – A real world Perspective", Outskirts Press, 2014.

Web-based/Online Resources:

1. http://www.isi.edu/nsnam/ns/doc/ns_doc.pdf
2. <https://www.nsnam.org/docs/release/3.22/tutorial/ns-3-tutorial.pdf>

Equipment / Facilities required to conduct the Practical Course.

Hardware Requirement:

- Desktop Computers / Laptop
- Printer

Software required:

1. Any Network Simulator

Options

- NS2
- NS3
- OMNeT++ (Objective Modular Network Testbed in C++)
- Cisco Packet Tracer
- GNS3 (Graphical Network Simulator-3)

5.6.2	INTERNET OF THINGS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Internet of Things (IoT) is presently a hot technology worldwide. Government, academia, and industry are involved in different aspects of research, implementation, and business with IoT. IoT cuts across different application domain like agriculture, space, healthcare, manufacturing, construction, water, and mining. This course will give a hands- on experience to the students in designing and developing Internet of Things applications and models. The course aims to groom the students to enable them to work on current technology and prepare the students to keep pace with the changing face of technology and the requirements of the growing IT industry.

Course Objectives:

After undergoing the subject, students will be able to:

- Understand the concepts of Internet of Things.
- understand the component parts of an IoT network and its connections
- identify the sensors and other devices needed for different IoT solutions
- Build small IoT applications with sensors and actuators
- Create the Thing Speak cloud and upload the data into the same

Course Outcomes:

On successful completion of this course, the student will be able to

CO1: Define IoT, its Components and Communication Models

CO2: Design the IoT Application with LED, LCD, IR Sensor and Ultrasonic Sensor and Switches CO3: Define IoT Design Methodologies

CO4: Create IoT Based application with sensors and upload the data in the Thing speak Cloud.

CO5: Describe the applications of IoT.

	INTERNET OF THINGS	L	T	P	C
PRACTICUM		1	0	4	3
Unit I	INTRODUCTION TO IOT				
Introduction to the IoT and IoT Devices -- IoT Configurations – Basic Components – IOT functional blocks- Sensors – Actuators - Introduction to Arduino – Arduino Programming Structure – Sketches – Pins – Basic functions in Arduino : digitalWrite(), digitalWrite(), pinMode(), delay(), loop(),setup()					5
Ex No 1: Creating different led patterns and controlling them using push button switches. Ex No 2: Display “Hello World “ in LCD 16X2 Display With Arduino					8
Unit II	DESCRIBING DATA				
IOT communication Models - IoT communication API's – Different types of Sensors- Integration of Sensors and Actuators with Arduino- Using Libraries in Arduino.					5
Ex No 3: Create the simple security system using IR sensor and Buzzer Ex No 4: Calculate the distance to an object with the help of an ultrasonic sensor and display it on an LCD.					8
Unit III	IOT & CLOUD				
IOT Levels: IOT Level-1- IOT Level-2- IOT Level-3-IoT Level-4 - IOT Level-5- IOT Level-6. Thing Speak Cloud – Setting up a cloud account in Thing Speak cloud platform.					5
Ex No 5: Interfacing Temperature Sensor (LM35) and humidity sensor Ex No 6: Upload Temperature and humidity data to Thing Speak with Node MCU/Raspberry Pi. Ex No 7: Create a simple application for Controlling of motor using input Switches. Ex No 8: Develop the simple Smart light system using PIR Sensor and Relays					14
TOTAL HOURS					45

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent Applications in IoT, Industry 4.0 and Digital Twins
- online quizzes
- Blended learning activities to explore the recent trends and developments in the field.
- Model Development

Text Books for Reference:

1. Jeeva Jose, "Internet of Things", First Edition, Khanna Book Publishing, 2018
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-On Approach ", First Edition, Orient Blackswan Private Limited, 2015.
3. Mayur Ramgir, "Internet of Things- Architecture, Implementation, and Security", First Edition, Pearson Education, 2019

Web-based/Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs65/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee85/preview
3. [Internet of Things: Design Concepts and Use Cases - Course \(swayam2.ac.in\)](https://swayam2.ac.in/)
4. <https://www.arduino.cc/en/IoT/HomePage>
5. <https://thingspeak.com/>
6. [IoT Projects and Tutorials using Arduino, Raspberry Pi, ESP8266 & NodeMCU \(iotdesignpro.com\)](https://iotdesignpro.com/)

5.7	OPEN ELECTIVE-III/ Advance Skill Development	L	T	P	C
PRACTICUM		2	0	0	0

5.7.1 Mechatronics

Course Content:

Unit 1 – Introduction to Mechatronics

- Introduction to System Concepts, Analysis and Design
- Mechatronics basic definitions; systems and components;
- Systems with mixed disciplines
- Electronics Fundamentals Review

Unit 2 – Elements in Mechatronics

- Data conversion devices, sensors, micro-sensors, transducers, signal processing devices, timers
- Microprocessors, Microcontrollers
- PID Controllers and PLCs

Unit 3 – Drives

- Stepper Motors, Servo Drives
- Linear Motion bearings, cams
- Systems controlled by camshafts, electronic cams
- Tool magazines and indexing mechanisms.

Unit 4 – Hydraulic Systems

- Flow, Pressure and Direction Control Valves
- Actuators, Supporting Elements, Hydraulic Power Packs, Pumps
- Design of Hydraulic circuits

Unit 5 – Pneumatic System

- Production, Distribution and conditioning of compressed air
- System Components and Graphic representations
- Design of Systems

5.7.2 Engineering Economics & Accountancy

Course Learning Objectives:

- To acquire knowledge of basic economics to facilitate the process of economic decision making.
- To acquire knowledge on basic financial management aspects.
- To develop the basic skills to analyze financial statements.

Course Content:

UNIT-I: Introduction: Managerial Economics; Relationship with other disciplines; Firms: Types, objectives and goals; Managerial decisions; Decision analysis.

Unit-II: Demand & Supply Analysis: Demand; Types of demand; Determinants of demand; Demand function; Demand elasticity; Demand forecasting; Supply; Determinants of supply; Supply function; Supply elasticity.

Unit-III: Production and Cost Analysis: Production function; Returns to scale; Production optimization; Least cost input; Isoquants; Managerial uses of production function; Cost Concepts; Cost function; Types of Cost; Determinants of cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost.

Unit-IV: Pricing: Determinants of Price; Pricing under different objectives and different market structures; Price discrimination; Pricing methods in practice; Role of Government in pricing control.

Unit-V: Financial Accounting (Elementary Treatment): Balance sheet and related concepts; Profit & Loss Statement and related concepts; Financial Ratio Analysis; Cash flow analysis; Funds flow analysis; Comparative financial statements; Analysis & Interpretation of financial statements; Investments; Risks and return evaluation of investment decision; Average rate of return; Payback Period; Net Present Value; Internal rate of return,

Reference Books:

1. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018
2. McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics',

Thomson South Western, 10th Edition, 2005.

3. Prasanna Chandra. 'Fundamentals of Financial Management', Tata Mcgraw Hill Publishing Ltd., 4th edition, 2005.

4. Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata Mcgraw Hill Publishing Company Limited, New Delhi, 2004.

5. Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Delhi, 2007. 3. Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson South Western, 4th Edition, 2001.

Elective – 3 (Pathway)

6.1.1	5G TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Introduction:

This course provides an in-depth understanding of 5G technology, covering foundational concepts, essential radio access technologies, core network architecture, protocols and standards, and emerging technologies in wireless communication.

Course Objectives:

The objective of this course is to enable the students to

- Understand the fundamental principles and evolution of wireless communication systems, including the transition from previous generations to 5G.
- Identify and explain the key features, requirements, and use cases of 5G networks in various industries and applications.
- Analyze the architecture and components of 5G networks, including radio access technologies, core network elements, and network slicing.
- Develop proficiency in radio access technologies such as OFDM, MIMO.
- Explore emerging technologies and applications in 5G, such as IoT, edge computing, and AI integration, and assess their impact on future communication systems.
- Gain hands-on experience in implementing and troubleshooting 5G networks through practical exercises and simulations.
- Understand the regulatory and standardization processes governing 5G deployment, ensuring compliance and interoperability with global standards.
- Analyze security protocols and mechanisms implemented in 5G networks to ensure data confidentiality, integrity, and availability.
- Develop critical thinking and problem-solving skills to address challenges and optimize performance in 5G network design, deployment, and management.

Course Outcomes:

On successful completion of this course, the student will be able to

C01: Understanding 5G principles, features, and applications.

C02: Proficiency in 5G radio access technologies.

C03: Mastery of 5G core network architecture and protocols.

C04: Knowledge of 5G protocol stack and interworking mechanisms.

C05: Exploring emerging technologies and applications in 5G networks.

	5G TECHNOLOGY	L	T	P	C
THEORY		3	-	-	3
Unit I	Introduction to 5G Technology				
Overview of wireless communication systems - Evolution from 1G to 5G - Key features and requirements of 5G networks - Comparison between 4G and 5G technologies - network latency and its importance in 5G - 5G spectrum bands and frequency ranges- Basics of network coverage and capacity in 5G - 5G enabled devices and their functionalities - role of AI and ML in enhancing 5G capabilities - network slicing and its benefits in 5G deployment - 5G architecture and network elements					9
Unit II	Radio Access Technologies in 5G				
Introduction to radio access technologies (RATs) and their role in wireless communication - multiple access techniques (FDMA, TDMA, CDMA) and their evolution in 5G - orthogonal frequency-division multiplexing (OFDM) and its significance in 5G - multiple-input multiple-output (MIMO) and its application - beam forming techniques - small cell deployment - heterogeneous network (HetNet) architecture .					9
Unit III	Core Network in 5G				
Evolution of core network architecture from 4G to 5G (e.g., LTE to NGC) - Network slicing and virtualization in 5G core - Service-based architecture (SBA) and control plane/user plane separation (CUPS) - Network functions virtualization (NFV) and software-defined networking (SDN) - Edge computing and mobile edge computing (MEC) in 5G networks					9
Unit IV	5G Protocols and Standards				
Overview of 5G protocol stack (PHY, MAC, RLC, PDCP, RRC, etc.) - 3GPP standardization process and release versions - NR (New Radio) air interface protocol architecture - Signalling procedures and message flows in 5G networks - Interworking and coexistence with legacy networks (e.g., LTE, Wi-Fi).					9
Unit V	Emerging Technologies and Applications in 5G				
Internet of Things (IoT) and machine-to-machine (M2M) communications in 5G - Vehicle- to-everything (V2X) communication and smart transportation systems - Augmented reality (AR), virtual reality (VR), and immersive multimedia applications. Network security and privacy considerations in 5G networks - Future trends and challenges in 5G technology development.					9
TOTAL PERIODS					45

Suggested List of Students Activity:

The following student activities or similar activities can be assigned for assessing IA marks

- Students are tasked with conducting research on the evolution of wireless communication systems, spanning from the first-generation (1G) to the fifth-generation (5G) networks. They gather information on the technological advancements, key milestones, and the impact of each generation on society and industries
- Using simulation software such as OPNET or NS-3, students simulate a 5G network deployment scenario. They configure parameters such as base stations, user equipment, and traffic patterns to model realistic network conditions.
- Students analyze a real-world case study of a 5G network deployment project. They examine the challenges faced by the network operators, the design decisions made during the deployment process, and the outcomes achieved.
- Students conduct an in-depth analysis of the signalling protocols used in 5G networks. They examine protocols such as the Radio Resource Control (RRC) protocol, Session Management (SM) protocol, and User Plane Protocol (UPP), studying their functionalities, message formats, and interactions.
- Each student selects an emerging technology relevant to 5G, such as Internet of Things (IoT), edge computing, or network slicing. They research the technology's principles, applications, and potential impact on 5G networks
- In the laboratory, students perform hands-on experiments related to radio access technologies or core network components. For example, students may configure and test a small-scale OFDM-MIMO system to understand its performance characteristics.
- Students collaborate in groups to design a 5G network architecture tailored to a specific use case or scenario. Each group conducts comprehensive research on network requirements, technology options, and deployment considerations. They develop a detailed network design proposal, considering factors such as coverage, capacity, scalability, and cost-effectiveness. Finally, groups present their design proposals to the class, showcasing their understanding of 5G network planning and their ability to address environmental and sustainability concerns.

Text Books:

1. AfifOsseiran, Jose F Monserrat, Patrick Marsch, "5G Mobile and Wireless CommunicationsTechnology", Cambridge University Press, 2016
2. 5G Mobile and Wireless Communications Technology, AfifOsseiran, Cambridge University Press, Second Edition,2011

3. 5G NR: The Next Generation Wireless Access Technology, Erik Dahlman, Elsevier, Ed.1st 2016
4. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, Wiley, First Edition

Text Books for Reference:

- Afif Osseiran, Jose F Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, 1st Edition, Cambridge University Press, 2016
- Erik Dahlman, 5G NR: The Next Generation Wireless Access Technology , 1st Edition, Elsevier, 2016.
- Jonathan Rodriguez , Fundamentals of 5G Mobile Networks, 1st Edition, Wiley, 2015
- Harri Holma, Antti Toskala, Takehiro Nakamura, “5G Technology 3GPP NEW RADIO”, John Wiley & Sons, 1/e, 2020.

Website Links for Reference:

NPTEL : <https://nptel.ac.in/courses/108/105/108105134/>

Udemy: <https://www.udemy.com/course/5g-mobile-networksmodern-wireless-communication-technology/>

6.1.2	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

Introduction

Project management is the systematic application of knowledge, skills, tools, and techniques to project activities to meet specific project requirements. It involves planning, organizing, and managing resources to achieve project goals within defined scope, time, and budget constraints. Project management encompasses several key processes and phases, including initiation, planning, execution, monitoring and controlling, and closing. It is essential across various industries to ensure projects are completed successfully, efficiently, and effectively, aligning with organizational objectives and stakeholder expectations. Project managers play a crucial role in leading teams, managing risks, ensuring quality, and communicating with stakeholders to drive project success.

Course Objectives

After completing this subject, the student will be able,

- To understand the concept, characteristics and elements of projects.
- To understand the stages in Project Life Cycle.
- To appreciate the need for Project Portfolio Management System.
- To know the considerations in choosing appropriate project management structure.
- To understand the components of techno-economic feasibility studies.
- To know about the detailed project report
- To learn about project constraints.
- To understand the techniques of evaluation.
- To get insight into the Social Cost Benefit Analysis Method.
- To know how to construct project networks using PERT and CPM.
- To learn how to crash project networks
- To understand the meaning of project appraisal.
- To understand the meaning of project audits.
- To know the qualities of an effective project manager.
- To understand the stages in Team Development model.

Course Outcomes

CO 1: Understand the Project Management Principles.

CO 2: Learn to create and manage project schedules.

CO 3: Create structure and manage the project commitments.

CO 4: Gain enterprise support.

CO 5: Prepare Detailed Project Report (DPR).

		L	T	P	C
	PROJECT MANAGEMENT				
Theory		3	0	0	3
UNIT I	Project Management – An Overview, Project Portfolio Management System and Structure, Steps in Defining Project and Project Delays				
	Project – Classification – Importance of Project Management – An Integrated Approach – Project Portfolio Management System – The Need – Choosing the appropriate Project Management Structure: Organizational considerations and project considerations – steps in defining the project – project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints.				7
UNIT II	Various Stages and Components of Project Feasibility Studies, Phases of a Project, Stages in Project Life Cycle and Project Constraints				
	Project feasibility studies - Opportunity studies, General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study – components of project feasibility studies – Managing Project resources flow – project planning to project completion: Pre-investment phase, Investment Phase and operational phase – Project Life Cycle – Project constraints.				7
UNIT III	Project Evaluation under Certainty and Uncertainty, Project Evaluation, Commercial and Social Cost Benefit Analysis				
	Project Evaluation under certainty - Net Present Value (Problems - Case Study), Benefit Cost Ratio, Internal Rate of Return, Urgency, Payback Period, ARR – Project Evaluation under uncertainty – Methodology for project evaluation – Commercial vs. National Profitability – Social Cost Benefit Analysis, Commercial or National Profitability, social or national profitability.				7

UNIT IV	Developing Project Network using PERT and CPM, Project Appraisal and Control Process.	
	Developing a Project Plan - Developing the Project Network – Constructing a Project Network (Problems) – PERT – CPM – Crashing of Project Network (Problems - Case Study) – Resource Leveling and Resource Allocation – how to avoid cost and time overruns – Steps in Project Appraisal Process – Project Control Process – Control Issues – Project Audits – the Project Audit Process – project closure – team, team member and project manager evaluations.	7
UNIT V	Project Managing Versus Leading of Project, Qualities of Project Manager and Managing Project Teams, Team Building Models and Performance Teams and Team Pitfalls.	
	Managing versus leading a project - managing project stakeholders – social network building (Including management by wandering around) – qualities of an effective project manager – managing project teams – Five Stage Team Development Model – Situational factors affecting team development – project team pitfalls.	7
	Revision and Test	10
	TOTAL HOURS	45

Suggested list of Students Activity,

Project Simulation and Role-Playing:

- Activity: Participate in simulated project scenarios where students take on different roles within a project team (e.g., project manager, team member, stakeholder).
- Purpose: This helps students understand the dynamics of project management, including leadership, communication, and team collaboration.

Case Study Analysis:

- Activity: Analyze real-world case studies of successful and failed projects.
- Purpose: This activity enables students to apply theoretical knowledge to practical situations, identify best practices, and learn from the challenges and solutions implemented in real projects.

Project Plan Development:

- Activity: Develop a comprehensive project plan for a hypothetical or real project, including scope, schedule, budget, risk management, and quality management plans.
- Purpose: This allows students to practice creating detailed and structured project plans,

honing their skills in planning and organizing project activities.

Group Project:

- Activity: Work in teams to manage a project from initiation to closure, simulating a real project environment.
- Purpose: Group projects help students learn how to work collaboratively, manage group dynamics, and apply project management tools and techniques in a team setting.

Project Management Software Training:

- Activity: Gain hands-on experience with project management software such as Microsoft Project, Asana, or Trello.
- Purpose: This activity equips students with practical skills in using technology to plan, track, and manage project tasks and resources efficiently.

Text Books for Reference:

1. Clifford F. Gray And Erik W. Larson, Project Management – The Managerial Process, Tata Mcgraw Hill.
2. Dragan Z. Milosevic, Project Management Toolbox: Tools And Techniques For The Practicing Project Manager,
3. Gopalakrishnan, P/ Ramamoorthy, V E, Textbook Of Project Management, Macmillan India. Ltd.
4. Harold Kerzner, Project Management: A Systems Approach To Planning, Scheduling, And Controlling, Eighth Edition, John Wiley & Sons
5. Jason Charvat, Project Management Methodologies: Selecting, Implementing, And Supporting Methodologies And Processes For Projects, John Wiley & Sons
6. Kevin Forsberg, Ph.D, Hal Mooz, Visualizing Project Management: A Model For Business And Technical Success, Second Edition, Pmp And Howard Cotterman, John Wiley & Sons.

Website Links for Reference:

<https://youtu.be/pc9nvBsXsuM>

NPTEL Courses

https://youtu.be/PqQqTAu_FiM

Elective – 4 (Specialisation)

6.2.1	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

This course is concerned with the development of applications on mobile and wireless computing platforms. Android will be used as a basis for teaching programming techniques. Students will work at all stages of the software development life-cycle from inception through to implementation and testing.

Course Objectives

The objective of this course is to

- To facilitate students to understand android SDK.
- To help students to gain a basic understanding of Android application development.
- To inculcate working knowledge of Android Studio development tool.
- To test Android applications.
- To deploy Android applications.

Course Outcomes

After successful completion of this course, the students should be able to C01: Identify various concepts of mobile programming that make it unique from programming for other platform.

C02: Critique mobile applications on their design pros and cons.

C03: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.

C04: Test Android applications.

C05: Deploy applications to the Android marketplace for distribution.

		MOBILE APPLICATION DEVELOPMENT		L	T	P	C
PRACTICUM				1	0	4	3
Unit I	INTRODUCTION TO MOBILE APPLICATION DEVELOPMENT						
Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building First Android application.							3
Ex. No	Name of the Experiment						
1	Implement “Hello World” Android example.						12
2	Develop an application that uses GUI components, Font and Colours.						
Unit II	INTRODUCTION TO ANDRIOD						
Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Android Manifest File and its common settings.							3
Ex. No	Name of the Experiment						
3	Develop an application that uses Layout Managers and event listeners.						12
4	Write an application that draws basic graphical primitives on the screen.						
Unit III	ANDROID USER INTERFACE DESIGN						
Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts.							3
Ex. No	Name of the Experiment						
5	Develop an application that makes use of Notification Manager.						12
6	Implement an application that writes data to the SD card.						
Unit IV	TESTING AND MANAGING ANDROID APPLICATIONS						
Testing Android applications, Publishing Android application, Using Android preferences.							3
Ex.No	Name of the Experiment						
7	Develop a native application that uses GPS location information.						12
8	Develop an application for sending & receiving SMS.						
Unit V	ANDROID APIs AND DEPLOYING ANDROID APPLICATION						
Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Using Android Networking APIs, Using Android Web and Telephony APIs, Deploying Android Application to the World.							3

Ex. No	Name of the Experiment	
9	Develop an application that makes use of SQLite databases.	12
10	Write an application that creates alarm clock.	
TOTAL PERIODS		75

Suggested List of Students Activity

- Presentation/Seminars by students on any recent technological developments based on the course
- Periodic class quizzes conducted on a weekly/fortnightly based on the course
- Micro project that shall be an extension of any practical lab exercise to real-world application

Textbook for Reference:

1. Dawn Griffiths, David Griffiths, "Head First Android Development: A Brain-FriendlyGuide", 1st edition, O'Reilly, 2017.
2. John Horton, Android Programming for Beginners, 2nd edition, Packt Publishing, 2018.
3. Barry Burd, Android Application Development All-in-One For Dummies, 2nd edition, For Dummies, 2020.

Website links for reference:

1. <https://developer.android.com/get-started/overview>
2. <https://developer.android.com/courses/>

6.2.1	E-COMMERCE AND DIGITAL MARKETING	L	T	P	C
PRACTICUM		1	0	4	3

RATIONALE

The course is designed to help you master the essential disciplines in digital marketing, including search engine optimization (SEO), social media, conversion optimization, web analytics, content marketing, email and mobile marketing. Digital marketing is one of the world's fastest growing disciplines.

LEARNING OUTCOMES

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

- Understand concepts of e-commerce.
- Identify core concepts of digital marketing and the role of digital marketing in business.
- Develop marketing strategies based on product, price, place and promotion objectives.
- Understand how they can use digital marketing to increase sales and grow their business
- Formulate marketing strategies that incorporate psychological and sociological factors which influence consumers.
- Hands on experience in using analytics tools eg: google analytics for report extraction and campaign measurement.
- Analyze marketing problems and provide solutions based on a critical examination of marketing information.
- Understand the opportunities for deploying emerging digital marketing media and techniques.
- Implement online campaigns for your business and marketing problems within the organization by learning adwords campaign management

DETAILED CONTENTS

1. Electronics Commerce & Business Models

(10 Periods)

Overview of E-Commerce: What it is, basic advantages (e.g., convenience, global reach) and disadvantages (e.g., security risks). **Business Models:** B2B (Business-to-Business) B2C (Business-to-Consumer) C2C (Consumer-to-Consumer) E-Governance (Government to Citizen)

Key Components: Four C's: Convergence, Collaboration, Content Management, Call Centres, Basics of Supply Chain Management

2. E-Commerce Payment

(6 Periods)

Basics of Payment Gateways, Main Modes of Payment: Cards, net banking, mobile wallets.
Security Measures: Encryption, SSL, safe browsing.

3. Digital Marketing Basics

(8 Periods)

What is Digital Marketing & Objectives, Main Tools & Activities: Search Engine Optimization (SEO) – basic intro, Social Media Marketing – Facebook, LinkedIn, YouTube basics, Content Marketing – simple

explanation, Email Marketing & Video Marketing basics, Importance of Mobile-Friendly (Responsive) Design, Google Analytics basics

4. Search Engine Optimization (SEO) (10 Periods)

Introduction to SEO – why it matters, How search engines work ,Basic Practices: Keywords and content hierarchy, Writing good headlines and meta descriptions, SEO for images & local SEO, Site speed basics and user engagement tips

5. Google Ads (AdWords) (6 Periods)

Basics of Google Ads: Setting up ad campaigns, Choosing keywords, writing ads, bid management and optimization

6. Google Analytics (8 Periods)

Introduction & Dashboard Basics, Basic metrics (visits, traffic sources), Understanding analytical reports, Using insights to improve website performance

7. Social Media Marketing (8 Periods)

Introduction to Social Media Marketing, Popular Platforms: Facebook, Instagram, LinkedIn
Creating Basic Business Pages & Content Posting, Simple Paid Advertising Concepts
Measuring Basic Performance (likes, comments, shares)

TOTAL 56

LIST OF PRACTICALS

1. Exploring E-Commerce Platforms:

Students can explore popular e-commerce platforms (like Amazon, Flipkart, or a local e-commerce site) to identify and list examples of B2B, B2C, and C2C models.

2. Creating a Simple Product Page:

Using a free website builder (like WordPress or Wix), students can create a basic product page to understand key e-commerce elements such as product descriptions, images, and pricing.

3. Analyzing Payment Gateway Integration:

Students can visit a demo payment gateway website and note down how payment options (cards, net banking, wallets) are presented and the security features (like HTTPS, padlock icon) that are visible.

4. Setting Up a Simple Social Media Page:

Students can create a basic business page on Facebook, Instagram, or LinkedIn, including a profile picture, description, and one or two sample posts.

5. Writing SEO-Optimized Headlines and Meta Descriptions:

Given a topic (e.g., “Best Laptops for Students”), students can practice writing a catchy headline and a brief meta description using the best SEO practices discussed in class.

6. Conducting Keyword Research:

Using a simple tool like Google Trends or Keyword Planner, students can find 5–10 relevant keywords for a chosen topic (e.g., “digital marketing basics”).

7. Creating a Simple Google Ad Campaign (Simulation):

Students can create a basic Google Ads campaign simulation by defining the ad group, choosing keywords,

and drafting a sample ad headline and text (this can be done in Google Ads “Draft” mode or using screenshots).

8. Setting Up Basic Google Analytics Tracking (Simulation):

Students can set up a simple Google Analytics account (using the free demo account or their own small site) and identify key metrics such as visitors, traffic sources, and top-performing pages.

9. Exploring Social Media Paid Promotions:

Students can research how to boost a Facebook post (using Facebook’s help pages or a simulated “boost post” scenario) and create a draft ad for practice.

10. Creating a Basic Digital Marketing Plan:

Students can create a one-page digital marketing plan for a hypothetical product or service, summarizing how they would use SEO, social media, and content marketing to reach customers.

Recommended websites

For Digital Marketing & SEO Basics:

- Google Digital Garage – free courses on digital marketing fundamentals
- Moz Beginner's Guide to SEO – easy-to-understand SEO tutorials

For Social Media Marketing:

- [Facebook Business Help Center](#) – learn about page creation and advertising
- Hootsuite Blog – best practices for social media marketing

For Google Ads & Analytics:

- Google Ads Help – tutorials and step-by-step guides
- Google Analytics Academy – free courses on using Google Analytics

6.2.2	DATA SCIENCE	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Data science is like being a digital detective, utilizing tools and algorithms to unveil hidden patterns in raw data. This course on Data Science equips learners with the ability to understand the process of Data Science, manipulate structured and unstructured data through various tools, algorithms, and software. This course also gives the insights about statistical data analysis and python libraries for data wrangling and data visualization. Data science is often considered as the twenty-first century's most lucrative career pathway this course gains much attention. This course also introduces basic machine learning algorithms.

Course Objectives:

- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for data wrangling.
- To present and interpret data using visualization libraries in Python
- To know the basic machine learning models

Course Outcomes:

On successful completion of this course, the student will be able to

C01: Define the data sciences and data science process

C02: Perform statistical calculation on data using python.

C03: Perform wrangling on data with python libraries

C04: Create effective visualization of given data

C05: Build data science applications with Support vector machines, Naive Bayes, Decision Trees and with Clustering algorithms.

	DATA SCIENCE	L	T	P	C
PRACTICUM		1	0	4	3
Unit I	INTRODUCTION TO DATA SCIENCE				
Data Science: Need, benefits and uses – facets of data -Data Science Process - Basics of Numpy Arrays.					3
Ex No 1: Create a Python List / tuple which stores the details of a student (rollno, name, dept, branch, percentage of mark) in Python and print the values. Ex No 2: Create the python list, convert the list and tuple as NumPy array and print its elements. Slice the NumPy array in to 3 slices and print all;					12
Unit II	DESCRIBING DATA				
Statistical Analysis: Mean Median, Mode, Standard Deviation, Range, Percentile. Missing value analysis - Numpy arrays : aggregations –computations on arrays, Introduction to Pandas					3
Ex No 3: Load your class Marklist data from a csv (comma-separated value) file into numpy array. Perform the following operations to inspect your array: Len(), ndim, size, dtype, shape, info(). Ex No 4:: Load a data into a pandas dataframe and perform following functions on it : min(), max(), cumsum(), mean(), median(), corrcoef(), std().					12
Unit III	PYTHON LIBRARIES FOR DATA WRANGLING				
Data manipulation with Pandas: data indexing and selection –missing data; Data Transformation: Removing duplicates- Replacing values -aggregation and grouping.					3
Ex No 5: Load a data into a pandas data frame, list out number of missing values in each column and fill the missing values with suitable default value. Ex No 6: Load two csv file into two data frame(d1,d2), combine both the Data frame and find and remove duplicate rows and rename indexes.					12
Unit IV	DATA VISUALIZATION				
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms - Visualization with Seaborn.					3

Practical: Iris Dataset is one of best know datasets in pattern recognition literature. This dataset contains 3 classes of 50 instances each, where each class refers to a type of iris plant. One class is linearly separable from the other 2 the latter are NOT linearly separable from each other. Attribute Information: • Sepal Length in cm , Sepal Width in cm • Petal Length in cm, Petal Width in cm Class: • Iris Setosa • Iris Versicolour • Iris Virginica Ex No 7: Load the Iris dataset, where observations belong to either one of three iris flower classes and visualize the average value for each feature of the Setosa iris class using a barchart with suitable linewidth and color. Ex No 8: Load the Iris dataset; plot all the column's relationships using a pairplot for multivariate analysis. Save the plot as JPEG file.		12
Unit V	Machine Learning Algorithms	
Basic Machine Learning Algorithms: Classification: Support vector machines- Naive Bayes- Decision Trees- Clustering- Confusion Matrix.		3
Ex.no 9 : Implement the Machine learning model for clustering with Iris dataset and analyse Decision Tree. Ex.no 10 : Implement the Machine learning model for clustering with Iris dataset and analyse K-means Clustering.		12
TOTAL PERIODS		75

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments in data science.
- online quizzes
- Blended learning activities to explore the recent trends and developments in the field.
- Model Development

Textbook for Reference:

- Davy Cielen, Arno D.B. Meysman, Mohamed Ali, Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools,, Manning Publications, 2016.
- Allen Downey, Think Stats: Exploratory Data Analysis in Python, Second Edition, O'Reilly, 2014.
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, , Second Edition, O'Reilly Media, 2019.

Website links for reference:

- NPTEL Course on Foundation of Data Science
https://onlinecourses.swayam2.ac.in/imb24_mg31/preview
- NPTEL Course on Python for Data Science
https://onlinecourses.nptel.ac.in/noc24_cs54/preview
- <https://www.kaggle.com/code/doukanelik/missing-values>
- <https://www.kaggle.com/code/mahnazarjmand/clustering-model-on-iris-dataset/input>
- <https://www.kaggle.com/datasets/saurabh00007/iriscsv/code>
- IBM Data Science Professional Certificate
<https://www.coursera.org/professional-certificates/ibm-data-science>

6.3.1	INDUSTRY INTERNSHIP	L	T	P	C
		-	-	-	-

Introduction

Internships in educational institutions are designed to provide students with practical experience in their field of study and to bridge the gap between academic knowledge and professional practice.

Objectives

After completing Internship, Interns will be able to,

- Apply the theoretical knowledge and skill during performance of the tasks assigned in internship.
- Demonstrate soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship.
- Document the Use case on the assigned Task.
- Enable interns to apply theoretical knowledge gained in the classroom to real-world practical applications.
- Provide hands-on experience in the industrial practices.
- Develop essential skills such as communication, organization, teamwork, and problem-solving.
- Enhance specific skills related to the intern's area of focus.
- Offer a realistic understanding of the daily operations and responsibilities.
- Provide opportunities to work under the guidance of experienced supervisors and administrators.
- Allow interns to explore different career paths.
- Help interns make informed decisions about their future career goals based on first hand experience.
- Facilitate the establishment of professional relationships with supervisor, administrators, and other professionals in the field.
- Provide access to a network of contacts that can be beneficial for future job opportunities and professional growth.
- Foster personal growth by challenging interns to step out of their comfort zones and take on new responsibilities.
- Build confidence and self-efficacy through successful completion of internship tasks and projects.
- Give insight into the policies, regulations, and administrative practices.
- Allow interns to observe and understand the implementation of standards and policies in practice.
- Provide opportunities for constructive feedback from supervisors and mentors, aiding in the intern's professional development.
- Enable self-assessment and reflection on strengths, areas for improvement, and career aspirations.
- Encourage sensitivity to the needs and backgrounds of different groups, promoting inclusive and equitable industrial practices.

Duties Responsibilities of the Faculty Mentor

- To facilitate the placement of students for the internship
- To liaison between the college and the internship provider

- To assist the Industrial Training Supervisor during assessment

Instructions to the Interns

- Students shall report to the internship provider on the 1st day as per the internship schedule.
- Intern is expected to learn about the organization, its structure, product range, market performance, working philosophy etc.
- The interns shall work on live projects assigned by the internship provider.
- The Intern shall record all the activities in the daily log book and get the signature of the concerned training supervisor.
- Intern shall have 100% attendance during internship programme. In case of unavoidable circumstances students may avail leave with prior permission from the concerned training supervisor of the respective internship provider. However, the maximum leave permitted during internship shall be as per company norms where they are working and intern shall report the leave sanctioned details to their college faculty mentor.
- The interns shall abide all the Rules and Regulations of internship provider
- Intern shall follow all the safety Regulations of internship provider.
- On completion of the internship, the intern shall report to the college and submit the internship certificate mentioning duration of internship, evaluation of interns by internship provider, Student's Diary and Comprehensive Training Report.

Attendance Certification

Every month students have to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Training Reports

The students have to prepare two types of reports: Weekly report in the form of diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

Comprehensive Training Report

In addition to the diary, students are required to submit a comprehensive report on training with details of the organization where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant/product/process/construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training.

Any data, drawings etc. should be incorporated with the consent of the Organization.

6.3.2	PROJECT	L	T	P	C
THEORY		2	0	0	0

RATIONALE

Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The students should identify themselves or accept the given project assignment at least two to three months in advance. The project work identified in collaboration with industry should be preferred. Each teacher is expected to guide the project work of 5–6 students.

The project assignments may consist of:

- Hardware based Project
- PC Repair & Maintenance Project
- Simulation of Server software services
- IoT Project

LEARNING OUTCOMES

After undergoing this subject, the student will be able to:

- Use effectively oral, written and visual communication
- Demonstrate skill and knowledge of current information and technological tools and techniques specific to the professional field of study.
- Identify, analyse and solve problems creatively through sustainment critical investigation.
- Develop, leadership abilities.
- Apply fundamental and disciplinary concepts and methods in ways appropriate to their areas of study.

A suggestive criterion for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No	Performance criteria	Max.** marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor

1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self-expression/ communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
Total marks		100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table

	Range of maximum marks	Overall grade
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

Important Notes

- 1. These criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**
- 2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**
- 3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
- 4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

The teachers are free to evolve another criterion of assessment, depending upon the type of project work.

The students must submit a project report of not less than 50 pages (excluding coding). The report must follow the steps of Software Engineering Concepts

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

6.4	ENTREPRENEURSHIP AND START-UP	L	T	P	C
THEORY		2	0	0	0

COURSE LEARNING OBJECTIVES:

- Acquiring Entrepreneurial spirit and resourcefulness.
- Familiarization with various uses of human resource for earning dignified means of living.
- Understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation.
- Acquiring entrepreneurial quality, competency, and motivation.
- Learning the process and skills of creation and management of entrepreneurial venture.

LEARNING OUTCOME:

Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

- Understanding the dynamic role of entrepreneurship and small businesses
- Organizing and Managing a Small Business
- Financial Planning and Control
- Forms of Ownership for Small Business
- Strategic Marketing Planning
- New Product or Service Development
- Business Plan Creation

COURSE CONTENT:

Unit 1 - Introduction to Entrepreneurship and Start – Ups

- Definitions, Classification of Entrepreneur
- Traits of an Entrepreneur, Intrapreneurship, Motivation
- Types of Business Structures- On the Basis of size and On the basis of ownership
- Similarities/differences between entrepreneurs and managers

Unit 2 – Business Ideas and their implementation

- Discovering ideas and visualizing the business
- Activity map
- Business Plan (Case Study)

Unit 3 – Ideas to Start-up

- Marketing and Accounting- Definition and Importance.
- Market Analysis – STP (Segmentation, Targeting, Positioning)

- Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
- Risk analysis- SWOT Analysis.

Unit 4 – Management

- Definition Concept and Functions of Management
- Company's Organization Structure- Concept and Classification
- Recruitment and Selection- Definition,
- Training and Development- Importance.

Unit 5 - Financing and Protection of Ideas

- Financing methods available for Entrepreneurship/ Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
- Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
- Communication of Ideas to potential investors – Investor Pitch.

Unit 6: Succession, Dissolution and Harvesting strategy

- Ways of succession
- Types of Dissolution

SUGGESTED LEARNING RESOURCES:

S. No.	Title of Book	Author	Publication
1.	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company	Steve Blank and Bob Dorf	K & S Ranch ISBN – 978-0984999392
2.	Entrepreneurship Development (A new Venture creation)	Vasant Desai	Himalya Publication
3.	Entrepreneurship Development	Khanka S.S.	S Chand & Company Limited New Delhi
4.	Entrepreneurship Development	Gupta and Srinivsan	S Chand & Company Limited New Delhi
5.	Demand: Creating What People Love Before They Know They Want It	Adrian J. Slywotzky with Karl Weber	Headline Book Publishing ISBN – 978-0755388974
6.	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN – 978-0670921607

7.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvard business ISBN: 978-142219602
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SUGGESTED SOFTWARE/LEARNING WEBSITES:

- <https://www.fundable.com/learn/resources/guides/startup>
- <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
- <https://www.finder.com/small-business-finance-tips>
- <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>
- NPTEL Course on Entrepreneurship
https://onlinecourses.nptel.ac.in/noc23_mg74/preview
- National Geographic Channel you tube Video on "GI Tag Crafts of Bharat"

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	17
2	04	14
3	05	20
4	06	17
5	06	21
6	02	11
Total	28	100

10. RESOURCE REQUIREMENT

10.1 Physical Resources

10.1.1 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.

10.1.2 Laboratoires/Shops

- Communication Skill Lab
- Applied Physics Lab
- Applied Chemistry Lab
- Technical Drawing
- Electrical Engineering Lab
- Carpentry Shop
- Painting and Polishing Shop
- Fitting and Plumbing Shop
- Sheet Metal Shop
- Programming Lab
- Hardware and Networking Lab
- Internet of Things (IoT) Lab
- Environment Engineering Lab
- Energy Conservation Lab
- Electronics Devices and circuits Lab
- Electronic Instruments and Measurement Lab
- Electronic Communication Lab
- Microprocessor Lab

LIST OF EQUIPMENT FOR COMPUTER SCIENCE AND ENGINEERING

Sr. No.	Description	Qty	Total Price (Rs)
COMMUNICATION SKILL LABORATORY			
1.	Stools	40	10,000
2.	Display Board/Screen	2	6,000
3.	Sound recording and playing system	1	6,000
4.	Audio cassettes	60	2,000
5.	Overhead Projector	1	5,000
6.	Transparencies slides	100	500
7.	TV, VCR and camera for video recording	1 each	20,000
8.	English spoken course	1	2,000
9.	A Quiz room equipped with two way audio system, back projection system and slide projector	1	30,000
10.	Miscellaneous	LS	1,500
APPLIED PHYSICS LABORATORY			
1.	Vernier calipers Working length 160 mm, Internal and external dia with locking arrangement	12	2,000
2.	Screw Gauges Working length 15 mm, pitch 0.5 mm, least count .005 mm	12	2,000
3.	Spherometers Distance between legs 2.5 mm, pitch 0.5 mm, least count .005 mm.	12	2,000
4.	Mirrors (convex, concave)	5 Each	1,500
5.	Pendulum Setup	02	4,000
6.	Gravesand's Apparatus	02	3,000
7.	Inclined Plane Setup	02	2,000
8.	Flywheel Setup	02	4,000
9.	Prism	05	1,500
10.	Spectrometer	02	25,000
11.	DC Ammeters Moving coil weston-type ammeter with ebonite stand	10	3,500
12.	DC Miliammeters	2	1,000
13.	DC Microammeters	2	700
14.	DC voltmeters	10	700

15.	DC Millivoltmeters	10	2,000
16.	Sensitivity Galvanometer	2	800

Sr. No.	Description	Qty	Total Price (Rs)
17	Student Galvanometers	10	4,000
18.	Demonstration type DC Ammeters Range; 0 to 1 Amp.	2	1,000
19.	D type DC Voltmeter Range : 0 to 1 Volt	2	1,000
20.	D type Galvanometers Sensitivity : 20 microamperes per scale division,	8	8,000
21.	Resistance boxes (dial type) assorted	8	8,000
22.	Rheostats	10	4,000
23.	Miscellaneous items (Spring, Pan, Glycerine, Optic fibre, Ferromagnetic material)	LS	2,000
24.	Fortin's Barometer (Wall type)	2	20,000
25.	Stoke's Apparatus	2	10,000
26.	Gumther's Apparatus	2	16,000
27.	Resonance Tube Apparatus with accessories and Tuning fork set	2	14,000
28.	Sodium Lamp setup with Biprism	2	10,000
29.	Ohmic resistance coil	10	5,00
30.	Slide wire bridge	2	8,000
31.	PN Junction diode Apparatus	2	10,000
32.	Laser (as per requirement)	1	1,00,000
33.	Numerical aperture setup	1	25,000
34.	Miscellaneous	LS	3,000

APPLIED CHEMISTRY LABORATORY

1.	Digital Balance	1	80,000
2.	Burette 50ml	30	3,000
3.	Pipette 25ml	60	4,000
4.	Beakers 100ml	60	4,000
5.	Burette stand	30	30,000
6.	Glazed tile	30	1,000
7.	Conical flask 50ml (Titration flask)	60	4,000
8.	Standard (Measuring) flask (to prepare standard solution) 250ml/100ml	30	6,000

9.	Able's Flash Point apparatus	2	10,000
10.	(1/10)°C thermometer	06	6,000
11.	Candles	20	100
12.	Crucible with lid	06	2,000
13.	Muffle furnace	1	18,000

Sr. No.	Description	Qty	Total Price (Rs)
14.	Decicators	06	8,000
15.	Pair of tongue (small and big)	24 (small) 2 (big)	2,000
16.	Chemicals - EDTA-1 kg - Eriochrome Black-T(solochrome black T)-200g - Buffer solution (NH₃ - 2.5 ltr, NH₄Cl – 1 kg) - Zinc sulphate- 500g - H₂SO₄- 2.5 ltr - Phenolphthalein indicator (as per requirement) - Methyl orange indicator (as per requirement) - Charcoal (as per requirement) - Kerosene- 1 ltr	LS	20,000
17.	Miscellaneous	LS	2,000

TECHNICAL DRAWING			
1.	Drawing Boards (700 x 500mm)	60	25,000
2.	Draughtsman Tables	60	1,80,000
3.	Draughtsman Stools	60	40,000
4.	Computer Aided Drawing (CAD) Software	30 User	5,00,000
5.	Model of different wooder joints	1	1,000
6.	Model of different screw threads	1	1,000
7.	Model of various locking devices	1	1,000
8.	Model of various joints	1	1,000
9.	Cut section Model of various couplings	1	3,000
10.	Miscellaneous	LS	5,000
ELECTRICAL ENGINEERING LABORTORY			
1.	Voltmeter	5	7,500
2.	Ammeter	5	10,000
3.	CRO	1	15,000
4.	Wattmeter	5	10,000
5.	Multimeter	1	4,000
6.	Resistive load	1	4,000
7.	Regulated supply	1	8,000
8.	Signal generator	1	5,000
9.	Rheostat	2	2,500
10.	Lead acid battery	1	4,000
11.	Cables, Coils, Lamp (as per requirements)	LS	1,500
12.	Resistance, Inductor, Capacitor (as per requirements)	LS	1,500
13.	Miscellaneous	LS	1,500
CARPENTRY SHOP			
Sr. No.	Description	Qty	Total Price (Rs)
1	Work benches fitted with carpenter vices	5	20,000
2.	Circular saw grinder	1	6,000
3.	Wood cutting band saw-vertical	1	10,000
4.	Bench grinder	1	5,000
5.	Drilling machine	1	8,000
6.	Wood turning lathe	1	40,000
7.	Wood Planner	1	20,000
8.	Tool accessories measuring and marking Instruments	25	25,000
9.	Band saw blade brazing unit	1	10,000
10.	Miscellaneous	LS	1,500

PAINTING AND POLISHING SHOP			
1.	Spray gun with hose pipe	1	1,000
2.	Paint brushes	20	2,000
3.	Paint/Varnish	LS	2,000
4.	Air Compressor with 2 hp motor	1 set	10,000
5.	Miscellaneous	LS	2,000
FITTING AND PLUMBING SHOP			
1.	Work benches with vices (4 vices on each bench)	5	30,000
2.	Marking tables with scribes	4	24,000
3.	Surface plates	5	20,000
4.	Accessories like calipers, V blocks, height, gauges steel rules and scribes	25	50,000
5.	Tool kits – taps, dies, drills	25	40,000
6.	Tool kits – chisels, hammers, files, hacksaw	25	25,000
7.	Drilling machine	2	12,000
8.	Pipe vice	4	1,000
9.	Chain wrenches	5	1,250
10.	Ring spanner set	5	600
11.	Pipe die set 2"	2 set	1,000
12.	Pipe bending device	1	5,000
13.	Various plumbing fittings	LS	2,000
14.	Miscellaneous	LS	1,500
SHEET METAL			
1.	Hammers	8	3,000
2.	Mallets (Hard & Soft)	5	2,000
3.	Sheet and wire Ganges	LS	8,00
4.	Shearing Machine	1	20,000
Sr. No.	Description	Qty	Total Price (Rs)
5.	Bar folding Machine	1	20,000
6.	Burring machine	1	10,000
7.	Various sheet (black plain, galvanized iron, corrugated, Aluminium)	1 Each	1,000
8.	Hand Shears/Snippers	4	2,000
9.	Nuts, Bolts, Rivets, Screw	LS	5,00
10.	Miscellaneous	LS	1,000

PROGRAMMING LAB			
1.	Computer Server (Quad core, intel processor 32 GB RAM)	1	5,00,000/-
2.	Computer Desktop (i7,8th Generation, 1TB Hard disk, 8Gb RAM, Pre loaded window with 5 year warranty)	60	48,00,000/-
3.	Switch with 24 port speed 10/100/1000 (Manageable)	3	1,50,000/-
4.	Multifunctional Laser/Ink tank Printer	3	90,000/-
5.	Multifunctional Printer, A3 size	1	40,000/-
6.	Plotter	1	80,000/-
7.	Scanner	1	65,000/-
8.	Laptop	1	75,000/-
9.	Online UPS, 6KVA	2	2,00,000/-
10.	Digital Camera, HD quality	1	30,000/-
11.	Handy Cam	1	25,000/-
12.	Internet Connectivity	60 Nodes	3,00,000/-
13.	LCD/DLP Projector with Screen	1	25,000/-
14.	Linux Operating System (Open Source)	-	-
15.	Visual Studio Community Edition (Freeware, Open Source)	-	-
16.	Visual Studio Code (Open Source)	-	-
17.	Multimedia Tools – Software - Blender (Freeware) - Gimp Animation Tool (Freeware)	-	-
18.	Mongo DB (Freeware)	-	-
19.	Python IDE (PyCharm/Eclipse with PyDev/VS Code etc) – Freeware	-	-
20.	HTML & CSS, Java Script, Ajax (Open Source)	-	-
21.	PHP IDE XAMPP/WAMPP/VS Code (Freeware)	-	-
22.	Word press (Open Source)	-	-
23.	Oracle XE (Freeware)/MySQL (Open Source)	-	-
24.	Corel Draw latest version or equivalent FOSS	10 User	2,00,000/-
Sr. No.	Description	Qty	Total Price (Rs)
25.	Adobe Creative Suite	10 User	2,50,000/- Per year
26.	Rstudio (Open Source)	-	-
27.	Macromedia Director latest version or equivalent FOSS	4 User	2,00,000/-

28.	Multimedia authoring Tools	LS	1,00,000/- Per year
29.	Java for Internet Environment (latest version) – software	-	-
30.	MS Office latest or equivalent FOSS - Libre Office/Open Office (Freeware)	1 -	20,000/- Per year -
31.	Compiler Turbo C, C++ or equivalent FOSS	1	10,000/-
32.	Web camera, Mike and speakers	LS	20,000/-
33.	Air Conditioner 2 ton	2	70,000/-
34.	STARUML (Open Source)	-	-
35.	J-Meter (Performance Testing)- Open Source	-	-
36.	Lucid Chart (Developing DFD Model)- Open Source	-	-
37.	Selenium (functional Testing and Web Application)- Open Source	-	-
38.	J Unit (Java Testing) Open Source	-	-
39.	Cross browser Testing (Compatibility Testing) - Open Source	-	-
40.	Gantt Project (Project Plan)- Open Source	-	-
41.	Video Editing Tools (Open Source)	-	-
42.	- Eclipse IDE for Java programming/JDK (Open Source) - Apache Tomcat Web Server for Advanced Java Web Applications	- -	- -
43.	Antivirus Software	5 Users	10,000/-
44.	Miscellaneous- cables and connectors, computer stationery, printer consumables (inks), toner etc.	LS	30,000/-

HARDWARE AND NETWORKING LAB

1.	Computer Server (Quad core, intel processor 32 GB RAM)	1	5,00,000/-
2.	Computer Desktop (i7,8th Generation, 1TB Hard disk, 8Gb RAM, Pre loaded window with 5 year warranty)	21	16,00,000/-
3.	Online UPS, 6KVA	1	1,00,000/-
4.	Switch with 24 port speed 10/100/1000 (Manageable)	1	50,000/-
5.	Connectors (RJ-45, RJ-11, BNC, SC, ST)	LS	10,000/-

Sr. No.	Description	Qty	Total Price (Rs)
6.	Cables: (UTP,STP,OFC) - 25 m each	LS	10,000/-
7.	Multifunctional Laser/Ink tank Printer	1	30,000/-

8.	Router	1	40,000/-
9.	Modem cum Router	2	10,000/-
10.	Compact Disk/DVD R/W	100	2000/-
11.	Hardware kit (for computer Assembling/de-assembling)	8	1,50,000/-
12.	External Hard Disk	4	30,000/-
13.	Networking Printer	1	1,25,000/-
14.	Internet Connectivity	21 Nodes	1,00,000/-
15.	Computer System Demonstration Kit	1	1,50,000/-
16.	Printer Demonstration Kit	1	1,00,000/-
17.	SMPS Demonstration Kit	1	20,000/-
18.	LAN Trainer	4	10,000/-
19.	Antivirus Software	5 Users	10,000/-
20.	Unmanaged Switch	4	60,000/-
21.	Hub	2	20,000/-
22.	Air Conditioner 2 ton	2	70,000/-
23.	Miscellaneous- cables and connectors, computer stationery, printer consumables (inks), toner etc.	LS	30,000/-

INTERNET OF THINGS (IoT) LAB (For IoT, Android and Major/Minor Project)

1.	Computer Desktop (i7,8th Generation, 1TB Hard disk, 8Gb RAM, Pre loaded window with 5 year warranty)	60	48,00,000/-
2.	Switch with 24 port speed 10/100/1000 (Manageable)	1	50,000/-
3.	Multifunctional Laser/Ink tank Printer	1	30,000/-
4.	Online UPS, 6KVA	2	2,00,000/-
5.	Touch screen, 60 inch	1	5,00,000/-
6.	Laptop	1	75,000/-
7.	Internet Connectivity	60 Nodes	3,00,000/-
8.	Photocopier Compatible with Computer System: Colour/Mono Photo-copier	1	1,50,000/-
9.	LCD/DLP Projector with Screen	1	25,000/-
10.	Video Conferencing System	1	2,00,000/-
11.	Android Studio (Open Source)	-	-
12.	Antivirus Software	5 Users	10,000/-

Sr. No.	Description	Qty	Total Price (Rs)
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13.	Windows Latest or equivalent FOSS	1	10,000/-
14.	SciLab (Open Source)	-	-
15.	Microsoft Azure/AWS/EC2 (Open Source)	-	-
16.	Own Cloud (Open Source)	-	-
17.	CloudSim (Open Source)	-	-
18.	Digital Board	1	30,000/-
19.	Air Conditioner 2 ton	2	70,000/-
20.	Arduino Uno IDE with built in Wifi	20	20,000/-
21.	Raspberry pi	2	6,000/-
22.	Sensor Kits (e.g. MQ135, DHT11 etc.)	10	1,00,000/-
23.	Bluetooth module HC05	10	3,500/-
24.	Display Screen	5	1,000/-
25.	Relay Module	5	5,000/-
26.	Miscellaneous- cables and connectors, computer stationery, printer consumables (inks), toner etc.	LS	30,000/-

ENVIRONMENT ENGINEERING LABORATORY			
1.	pH Meter	01	500
2.	Turbidity Meter	01	5000
3.	Oven with Temperature Controller and Forced Air Circulation Type	01	20000
4.	B.O.D. Incubator	01	25000
5.	Water Analysis Kit	01	5000
6.	High Volume Sampler	01	40000
7.	Electrical Balance for weighing upto 1/10 of milligram (capacity)	01	1000
ENERGY CONSERVATION LABORATORY			
1	Clamp meter	02	5000
2	Multimeter	02	2000
3	Power Analyser	01	20000
4	Different types of lamps (LS) – 60 W lamp, 230 V , 100 V – 200 W lamp – 500 W lamp – 100 W lamp, 110 V, 150 V	10	500
5	Lux meter	02	5000

6	Centrifugal pump, 1 kW	1	15,000
7	Standard window A.C.	01	20000
8	Anemometer	02	5000
9	Thermometer	03	2000
10	Flow meter	02	10000
11	Pumping set with at least two pumps of different capacity.	1 set	10000
12	Pressure gauge fitted on discharge lines	1 set	2000
13	Variable Frequency Drive	02	50000
14	A small compressor with a small network of pipe line fitted with suitable pipeline, pressure gauge, safety valve and loading / unloading pressure switch.	1	3000
15	Stop watch	2	1000
16	Small blower (1.5 kW motor) with inlet and outlet ducts of approximately one meter length on both sides	1	10000
17	Black Box (for checking lamp efficacy including stand and luxmeter)	1	25000
Electronic Devices and Circuit Lab			
1	CRO	2	40000
2	Zener Diode Kit	2	8000
3	Digital Multimeter	3	6900
4	Function Generator	2	28000
5	Set of Resistors (Multiple Values)	2 set	500
6	Set of Capacitor (Multiple Values)	2set	600
7	Set of Inductor	1 set	300

8	Set of Diode (PN , Zener)	2 set	600
9	Set of BJT (BC107 , SL100)	2 set	500
10	Set of JFET (2N547 ,MPF102)	1 set	250
11	Set of MOS (IRF540 , AO4620)	10 pc	500
12	OP-AMP (741 IC)	8 pc	400
13	555 Timer IC	10pc	500
14	Breadboard	6	1800
15	Operational Amplifier as Adder and Subtractor kit	5	20000
16	Pushpull amplifier kit	2	8000
17	Wein bridge oscillator and phase shift oscillator	2	10000
18	Hartley and colpitts oscillator	2	8000
19	Clipper clamper kit	3	15000
20	Logic Gate IC(AND,OR,NOR.NAND,EXOR,EXNOR)	10 EACH	500
21	Logic gate kit	1	4000
23	Flip Flop kit	2	8000
24	MUX-DEMUX kit	1	5000
25	Encoder and Decoder kit	1	4800
26	CMOS and TTL transfer characteristics kit	1	4900
27	Breadboard	6	1800
Electronic Instruments and Measurement Lab			
1	DSO	1	35000

2	CRO	2	40000
3	Wheat stone bridge	2	7000
4	RLC bridge	1	6000
5	Maxwell bridge	1	4500
Electronic Communication Lab			
1	CRO	2	40000
2	AM MODULATOR	1	4500
3	FM MODULATOR	1	5500
4	Sampling and reconstruction kit	1	4400
5	PPM &PWM KIT	1	5500
6	ASK,FSK,DPSK KIT	1	6000
7	PSPIICE SOFTWARE		
8	GSM TRAINER KIT WITH GSM MOBILE	1	20000
9	Transmitting antenna measurement kit	1	5000
Microprocessor Lab			
1	8085 MP kit	8	80000
2	8086 mp kit	2	20000

NOTE

In addition to above laboratories, computer centre will be required for effective implementation of the course.

10.1.3 Furniture Requirement

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

- Furniture for laboratories/Computer Centre 15 lacs

10.2 Human Resources

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.

11. EVALUATION STRATEGY

11.1 INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor 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
- Professional Industrial Training

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	Upto 10 percent

B. Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/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 Work

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.

D. Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behaviour, quality of report and presentation during viva-voce.

11.3 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 IRDT 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.

12. 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. Punjab State Board of Technical Education (PSBTE) 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 upto grass-root level. Polytechnics in turn are supposed to prepare institutional academic plan by referring state level PSBTE plan.
3. HOD of every Programme Department along with HODs and incharges of other departments viz. English, Maths, Physics, Chemistry etc. 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 practicals, 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 PSBTE 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 feed back 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.

The following experts have participated in workshop for Developing the Curricula Structure and Contents of Diploma in Communication and Computer Networking for UP State at IRDT U.P. Kanpur:

1. Dr. Vijay Yadav, Lecturer IT, Government Girls Polytechnic Charkhari Mahoba.
2. Priyanka Shukla, Lecturer Web Designing, Government Polytechnic, Kanpur
3. Saurabh Sachan, Lecturer Computer, Government Polytechnic, Deeh Unnao
4. Mudresh Mohan Tripathi, Lecturer Computer Hardware & Networking, Government Polytechnic, Kanpur
5. Komal, Lecturer, Computer Hardware & Networking, Government Polytechnic, Lucknow
6. Anurag Singh, Lecturer Web Designing, Government Polytechnic, Kanpur
7. Gaurav Kishor Kanaujiya, Assistant Professor IRDT U.P. Kanpur

Annexure: 1

Proposed Courses by TATA Technology (Advance Skill Certification)

S. No.	Course Name
1	Fundamentals of Innovation and Design Thinking
2	Product Design and Development
3	Product Verification and Analysis
4	Advanced Automobile
5	Electric Vehicle
6	Internet of Things
7	Advanced Manufacturing
8	Advanced Welding & Painting using Simulator
9	Industrial Automation and MES
10	Industrial Robotics
11	Inspection and Quality Control
12	Advanced Plumbing
13	AI and ML