MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

Estd. 2000

IQAC

MUST KNOW CONCEPTS

MKC

ECE

2021-22

Subject		19ECE25 / Internet of Things		
S. No.	**Term**	**Notation Symbol)**	**Concept/Definition/Meaning/Units/Equation/Expression**	**Units**
UNIT I OVERVIEW OF IOT				
1.	Internet of Things (IoT)		Internet of Things (IoT) is a network of physical objects or people called "things" that are embedded with software, electronics, network, and sensors that allows these objects to collect and exchange data.	
2.	IoT Communication mediums		• Mobile or satellite networks, • Bluetooth, • WI-FI, • WAN, etc.	
3.	Challenges of Internet of Things (IoT)		• Insufficient testing and updating • Concern regarding data security and privacy • Software complexity • Data volumes and interpretation • Integration with AI and automation • Devices require a constant power supply which is difficult • Interaction and short-range communication	
4.	Advantages of IoT		• Technical Optimization • Improved Data Collection • Reduced Waste • Improved Customer Engagement	
5.	Disadvantages of IoT		• Security • Privacy • Flexibility • Complexity • Compliance	
6.	IoT Best Practices		• Design products for reliability and security • Use strong authentication and security protocols • Disable non-essential services • Ensure Internet-managed, and IoT management hubs & services are secured	

			• Energy efficient algorithms should be designed for the system to be active longer.	
7.	Four Key components of IoT framework		1) Sensors/Devices, 2) Connectivity, 3) Data Processing, 4) User Interface	
8.	IIOT		Industrial Internet of Things in which Communication transportation is done through both wired and wireless devices.	
9.	Layers of IoT protocol stack		1) Sensing and information, 2) Network connectivity, 3) Information processing layer, 4) Application layer.	
10.	Mostly used sensors types in IoT		• Smoke sensor • Temperature sensors • Pressure sensor • Motion detection sensors • Gas sensor • Proximity sensor • IR sensors	
11.	Applications of PWM in IoT		• Controlling the speed of DC motor, • Controlling the direction of a servo moto, • Dimming LED, etc.	
12.	Arduino		Arduino is an open, programmable USB microcontroller that can execute one program at a time	
13.	IoT Thingworx		• Thingworx is a platform for the fast development and deployment of connected devices. • It is a collection of integrated IoT development tools that support analysis, production, property, and alternative aspects of IoT development.	
14.	Salesforce IoT Cloud		The Salesforce IoT Cloud is an online platform for storing and processing IoT information	
15.	GPIO		GPIO is a programmable pin that can be used to control input or output pins programmatically.	
16.	Suitable databases for IoT		• Influx DB • Apache Cassandra • RethinkDB • MongoDB • Sqlite	
17.	IoT network technologies		• LPWAN • Cellular • Bluetooth Low Energy (BLE) • ZigBee • near field communication (NFC) • Radio Frequency Identification (RFID) • WiFi	

			• Ethernet	
18.	6LoWPAN		IPv6 over Low-Power Wireless Personal Area Networks	
19.	Internet Layer IoT Network Technologies		• IPv6, • 6LoWPAN, and • RPL.	
20.	Messaging protocols frequently used within IoT applications		• Message Queue Telemetry Transport (MQTT) • Advanced Message Queuing Protocol (AMQP), and • Extensible Messaging and Presence Protocol (XMPP)	
21.	IoT testing tools		• IoT testing software: Tcpdump and Wireshark. • Hardware for IoT testing: JTAG Dongle, Digital Storage Oscilloscope, and Software Defined Radio.	
22.	IoT software		1) Blockchain, 2) windows IoT, 3) Predix, 4) Microsoft Azure, 5) Bluemix, and 6) Node-RED.	
23.	Shodan		• Shodan is an IOT testing tool that can be used to discover which of your devices are connected to the Internet. • It allows you to keep track of all the computers which are directly accessible from the Internet.	
24.	IoT test approaches		1) Usability, 2) IoT Security, 3) Connectivity, 4) Performance, 5) Compatibility Testing, 6) Pilot Testing, 7) Regulatory Testing, and 8) Upgrade testing.	
25.	Hardware Prototypes used in IoT		1) Raspberry Pi, 2) ARM Cortex Family, and 3) Arduino.	
UNIT II IOT ARCHITECTURE				
26.	IoT Reference Model		• IoT Reference Model defines a set of levels with control flowing from the center (this could be either a cloud service or a dedicated data center), to the edge, which includes sensors, devices, machines, and other types of intelligent end nodes.	
27.	Seven layers of the IoT		• Layer 1: Physical Devices and Controllers Layer • Layer 2: Connectivity Layer	

	Reference Model.		• Layer 3: Edge Computing Layer • Layer 4: Data accumulation Layer • Layer 5: Data abstraction Layer • Layer 6: Applications Layer • Layer 7: Collaboration and processes layer	
28.	Connectivity Layer Functions		• Communications between Layer 1 devices • Reliable delivery of information across the network • Switching and routing • Translation between protocols • Network level security	
29.	Layers in three-layer architecture IoT		• Perception layer • Network layer • application layer	
30.	Layers in five-layer architecture IoT		• Perception layer • Transport layer • Processing layer • Application layer • Business layer	
31.	The three data management layers		• The edge layer (data management within the sensors themselves), • The fog layer (data management in the gateways and transit network), and • The cloud layer (data management in the cloud or central data center).	
32.	Perception Layer		Manages smart devices across the system.	
33.	Connectivity/Transport Layer		Allows transferring data from the cloud to devices and vice-versa, different aspects of gateways and networks.	
34.	Processing Layer		Controls and manages IoT levels for streamlining data across the system.	
35.	Application Layer		Aids in the procedures of analytics, device control, and reporting to end-users.	
36.	Business Layer		Derives information and decision-making analysis from data.	
37.	Security Layer		Covers all aspects of protecting the whole IoT architecture	
38.	Edge computing Layer		Works at an edge or near the device information collection.	
39.	Two main stages in processing layer		• Data Accumulation • Data Abstraction	
40.	Types of IoT		• **Internet of Things:** It creates a business that uses a gadgets to perform a task. • **Industrial Internet of Things:** It creates business in the industry like agriculture	
41.	Essential Device security		• Secure boot process to avoid any malicious code	

	measures		running on a device • Using Trusted Platform Module (TPM) chips in combination with cryptographic keys for devices endpoint protections • Extra physical layer to avoid direct access via the device • Regular updates for security patches • Cloud Security	
42.	IoT Cloud		An IoT cloud is a massive network that supports IoT devices and applications	
43.	Bluetooth Low Energy (BLE)		• Bluetooth Low Energy is a wireless, low-power personal area network that operates in the 2.4 GHz ISM band. • Its goal is to connect devices over a relatively short range. • BLE was created with IoT applications in mind, which has particular implications for its design.	
44.	Spectrum range of BLE		Bluetooth Low Energy technology operates in the same spectrum range (the **2.400–2.4835 GHz ISM band**) as classic Bluetooth technology, but uses a different set of channels.	
45.	BLE channels		Instead of the classic Bluetooth 79 1-MHz channels, Bluetooth Low Energy has 40 2-MHz channels	
46.	Bluetooth version that enables bluethooth low energy		Bluetooth 4.0	
47.	Beacon		Beacon is a small bluetooth device that repeatedly transmits signals that other devices like your smartphone can see. Beacon broadcasts radio signal that is a combination of letters and numbers approximately every 1/10th of a second.	
48.	3 Beacon IoT Use Cases		• Beacon IoT Ads Application • Beacon-Powered Smart Shelves • Beacon IoT App for Local News	
49.	Features of Bluethooth 5.0		• Three times faster transmission speed • Low power consumption through reduced duty cycle • Backward compatibility to earlier versions • Further improved BER performance • Simplification of multi-link scenario	
50.	Security in Bluetooth		Bluethooth uses the SAFER+ algorithm for authentication and key generation.	
UNIT-III: WIRELESS TECHNOLOGY FOR IOT				
51.	wireless IoT		• Wireless technology is a method of connection within an IoT system that includes sensors,	

			platforms, routers, applications, and other systems. Each option has trade-offs between power consumption, bandwidth, and range	
52.	Types of IoT Wireless Technology		• LPWANs • Cellular (3G/4G/5G) • Zigbee and Other Mesh Protocols • Bluetooth and BLE • Wi-Fi • RFID	
53.	IEEE 802.11		• IEEE 802.11 standard, popularly known as WiFi, lays down the architecture and specifications of wireless LANs (WLANs). • It provided 1 Mbps or 2 Mbps data rate in the 2.4 GHz band	
54.	Bluetooth		Bluetooth is a short-range wireless technology standard that is used for exchanging data between fixed and mobile devices over short distances.	
55.	Components of IEEE 802.11		Station (STA) Basic service set (BSS) Extended service set (ESS) Distributed system (DS)	
56.	Bluetooth Range		Using UHF radio waves in the ISM bands, from 2.402 to 2.48 GHz, and building personal area networks	
57.	RFID		RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.	
58.	Uses of RFID		• Contactless access control systems. • Contactless payments. • Electronic passports and citizen ID cards. • Retail logistics. • Automation & manufacturing. • Returnable transport Items.	
59.	Types of RFID tags		• Active (powered), • passive (un-powered) or • semi-passive (battery-assisted).	
60.	Maximum range of the RFID module		An active RFID system can read tags from 1,500 feet away or more, as the tags broadcast a signal and the systems are designed for longer-range applications.	
61.	6LoWPAN		• 6LoWPAN is an IPv6 adaptation layer defined by the IETF 6LoWPAN working group that describes how to transport IPv6 packets over IEEE 802.15.4 layers. • RFCs document header compression and IPv6 enhancement to cope with the specific details of	

			IEEE 802.15.4	
62.	Use of 6LoWPAN		• Wireless sensor networks, and • The Thread protocol for home automation devices also runs over 6LoWPAN.	
63.	UWB		Ultra-WideBand is a radio technology that can use a very low energy level for short-range, high-bandwidth communications over a large portion of the radio spectrum.	
64.	UWB Applications		• Data communication, • Localization and Identification • radar and Sensing applications	
65.	Range of UWB		• UWB can detect the location of a device over a range under 200 meters. • It operates most effectively over short ranges, generally between 1-50 meters	
66.	Difference between UWB and Wi-Fi		• UWB can track a bigger number of assets at large distances. • It can detect with high accuracy where in the room the object is, while Wi-Fi-based RTLS provides information only about the presence or absence of the asset in the required room. • RTLS Ultra Wide Band sensor gives less interference	
67.	ZigBee wireless		Zigbee is a standards-based wireless technology developed to enable low-cost, low-power wireless machine-to-machine (M2M) and internet of things (IoT) networks	
68.	ZigBee types		• The ZigBee Coordinator (ZC), • The ZigBee Router (ZR), and • The ZigBee End Device (ZED).	
69.	Zigbee Advantage		• Support for multiple network topologies such as point-to-point • Low duty cycle – provides long battery life. • Low latency • Direct Sequence Spread Spectrum (DSSS) • Up to 65,000 nodes per network • 128-bit AES encryption for secure data connections • Collision avoidance, retries and acknowledgements	
70.	6LoWPAN		6LowPAN is a network protocol that defines encapsulation and header compression mechanisms	
71.	6LoWPAN protocol		6LoWPAN is a low power wireless mesh network where every node has its own IPv6 address.	
72.	features of 6LoWPAN		• Devices Properties. Low Routing State • Link Properties. Minimal Routing Overhead • Network Characteristics. Periodically Hibernate • Security • Confidentiality and Authentication • Mesh under Forwarding.	

			• MAC Addresses	
73.	Main function of 6LoWPAN		• It is low power wireless mesh network where every node has its own IPv6 address. • This allows the node to connect directly with the Internet using open standards.	
74.	6LoWPAN security measures		• The 6LoWPAN group has its own encapsulation and header compression mechanisms. • This enables IPv6 packets to be sent and received over IEEE 802.15. 4 based networks. • IPv4 and IPv6 provide data delivery for LANs, MANs, and WANs.	
75.	Zigbee Disadvantages		The technology used in Zigbee is of low bit rate, the transmission rate of this technology is also low.	
UNIT IV: BUILDING IOT WITH RASPBERRY PI				
76.	Raspberry Pi		• Raspberry Pi is a computer which is capable of doing all the operations like a conventional computer. • It has other features such as onboard WiFi, GPIO pins, and Bluetooth in order to communicate with external things.	
77.	wireless communications boards available in Raspberry Pi		• WiFi and • BLE/Bluetooth	
78.	Models of Raspberry Pi		• Raspberry Pi 1 Model B • Raspberry Pi 1 Model B+ • Raspberry Pi 1 Model A • Raspberry Pi Zero • Raspberry Pi 3 Model B • Raspberry Pi 1model A+ • Raspberry Pi Zero W • Raspberry Pi 2	
79.	Raspberry PI Interfaces:		• SPI, • serial interface • I2C interfaces	
80.	5 pins Raspberry for SPI interface.		1. MISO(Master In Slave Out) 2. MOSI(Master Out Slave In) 3. SCK(Serial Clock 4. CE0(Chip Enable 0) 5. CE1(Chip Enable 1)	
81.	I2C		• I2C Interface pins are used to connect hardware modules. • I2C interface allows synchronous data transfer with two pins: SDA(data line) and SCL (Clock Line)	
82.	Features of Raspberry PPI		• RASPBERRY PI 3 has wireless LAN and Bluetooth facility by which you can setup WIFI HOTSPOT for internet connectivity	

			• RASPBERRY PI had dedicated port for connecting touch LCD display which is a feature that completely omits the need of monitor. • RASPBERRY PI also has dedicated camera port so one can connect camera without any hassle to the PI board. • RASPBERRY PI also has PWM outputs for application use. • It supports HD steaming	
83.	Applications of Raspberry pi		• Hobby projects. • Low cost PC/tablet/laptop • IoT applications • Media center • Robotics • Industrial/Home automation • Server/cloud server • Print server • Security monitoring • Web camera • Gaming • Wireless access point	
84.	Use of Raspberry pi in IoT		• Raspberry Pi can be used as a platform to develop many Internet of Things project. • It is simple to use Raspberry Pi because it uses Linux OS in a small card like a computer.	
85.	Components of Raspberry Pi		• The Raspberry Pi board contains a 700 or 900 MHz processor with a minimum memory provision of 128 MB. • It has an additional slot for memory card too. • There is a graphics set up, USB port for connecting keyboard or mouse. • Raspberry Pi comes along with an audio or video output option to connect your monitor. • There is an HDMI port too for connecting with TV.	
86.	GPIO pins used in Raspberry Pi		GPIO pins used in the Raspberry Pi boards to make an interface between the Raspberry Pi and all the components of the board.	
87.	Difference between Audino and Raspberry Pi		• Raspberry Pi uses Linux OS and is a general purpose microcomputer. • It is capable of running multiple programs at a time, while the Arduino is a simple microcomputer that is capable of running one program only.	
88.	Benefits of Raspberry Pi		• Low cost (~35$) • Huge processing power in a compact board • Many interfaces (HDMI, multiple USB, Ethernet, onboard Wi-Fi and Bluetooth, many GPIOs, USB powered, etc.) • Supports Linux, Python (making it easy to build	

			applications) • Readily available examples with community support • Developing such an embedded board is going to cost a lot of money and effort	
89.	Cons of Raspberry Pi		• Missing eMMC Internal Storage • Graphics Processor Missing • Impractical as a Desktop Computer • Overheating • Not able to run Windows Operating system	
90.	SPI		• **SPI:** Serial Peripheral Interface (SPI) is a synchronous serial data protocol used for communicating with one or more peripheral devices.	
91.	Five pins on Raspberry Pi for SPI interface :		• **MISO (Master in slave out)** – Master line for sending data to the peripherals. • **MOSI (Master out slave in)** – Slave line for sending data to the master. • **SCK (Serial Clock)** – Clock generated by master to synchronize data transmission • **CE0 (Chip Enable 0)** – To enable or disable devices • **CE0 (Chip Enable 1)** – To enable or disable devices	
92.	API		• API is the acronym for Application Programming Interface, which is a software intermediary that allows two applications to talk to each other.	
93.	Best Lightweight Operating Systems for Raspberry Pi		8 Best Lightweight Operating Systems for Raspberry Pi • Raspberry Pi OS Lite. • DietPi. • piCore/Tiny Core Linux. • Arch Linux ARM. • RISC OS. • Raspup/Puppy Linux. • Sugar on a Stick/Sugar OS. • Alpine Linux	
94.	Instruction set architecture used in raspberry Pi		ARM	
95.	Distributions supported by Raspberry Pi		• Arch Linux • Debain • Fedora remix	
96.	WiFi not present in which model of Raspberry Pi		Raspberry Pi Zero	
97.	Speed of operation of Raspberry Pi 2 and 3		• Raspberry Pi 2 : 900 MHz • Raspberry Pi 3 : 1.2 GHz	

98.	Number of USB ports in Raspberry Pi3		Four	
99.	Ethernet/LAN cable used in RPi		RJ45	
100.	Difference between API and web services		All web services are APIs, but not all APIs are web services.	
UNIT V: SERVICE LAYER PROTOCOL & SECURITY				
101.	security issues in the IoT		• Vulnerabilities. Vulnerabilities are a large problem that constantly plague users and organizations. ... • Malware. ... • Escalated cyberattacks. ... • Information theft and unknown exposure. ... • Device mismanagement and misconfiguration.	
102.	major security and privacy concerns in IoT		• Authentication, • Identification and • device heterogeneity	
103.	IoT Security		IoT security is the technology segment focused on safeguarding connected devices and networks in the internet of things (IoT).	
104.	IoT security methods		• Network access control • Segmentation • Security gateways • Patch management/continuous software updates • Training • Integrating team • Consumer education	
105.	key requirements for any IoT security solution		• Device and data security, including authentication of devices and confidentiality and integrity of data. • Implementing and running security operations at IoT scale. • Meeting compliance requirements and requests. • Meeting performance requirements as per the use case.	
106.	Requirements for Secure adoption of IoT		• Enabling mutual authentication between connected devices and applications • Maintaining the integrity and confidentiality of the data collected by devices • Ensuring the legitimacy and integrity of the software downloaded to devices • Preserving the privacy of sensitive data in light of stricter security regulations	
107.	Public key infrastructure (PKI)		Set of hardware, software, policies, processes, and procedures required to create, manage, distribute, use, store, and revoke digital certificates and public-keys.	

108.	Use of PKI in IoT		PKIs deliver the elements essential for a secure and trusted business environment for e-commerce and the growing Internet of Things (IoT).	
109.	DDS (Data Distribution Service)		DDS (Data Distribution Service) is another scalable IoT protocol that enables high-quality communication in IoT. Similar to the MQTT, DDS also works to a publisher-subscriber model.	
110.	The IoT Service functional components		A collection of service implementations, which interface the related and associated Resources.	
111.	Service descriptions of IoT Services		Contain a number of attributes as seen earlier in the IoT Functional Model section	
112.	Virtual Entity Service functional components (FC)		Virtual Entity Service FC enables the interaction between Users and Virtual Entities by means of reading and writing the Virtual Entity attributes (simple or complex), which can be read or written	
113.	Management Service Layer		The management Service layer is responsible for Securing Analysis of IoT devices, Analysis of Information (Stream Analytics, Data Analytics), Device Management.	
114.	Application layer		Application layer forms the topmost layer of IoT architecture which is responsible for effective utilization of the data collected.	
115.	key components of a M2M system		• Sensors • RFID (Radio Frequency Identification) • Wi-Fi • Autonomic Computing.	
116.	XMPP		Extensible Messaging and Presence Protocol (XMPP) is used in IOT which covers XMPP core, XMPP addressing, XMPP server and XMPP client communication. XMPP is the short form of Extensible Messaging and Presence Protocol.	
117.	Type of architecture used by XMPP		Decentralized client-server architecture where clients do not talk directly to one another, but there is no central server.	
118.	API allows the user to control electronic components.		RETful API	
119.	Boot		It allows us to monitor the application in IoT.	
120.	Class client()		Publishing messages is handled through Class	
121.	Service models that is restrictive & refined more		Paas –Platform as a service (Paas)	
122.	Platform that provides Amazon Web Services		Paas –Platform as a service	

	with Service Oriented Architecture (SOA. Approach			
123.	IaaS – Infrastructure as a Service		Hardware Assets like virtual storage, virtual infrastructure, and virtual machines are provided	
124.	WSDL		WSDL is **an XML notation for describing a web service. It is** used to describe the service interface, how to bind information, and the nature of the component's service or endpoint	
125.	SOA – Service oriented architecture		a message-passing taxonomy for a component-based architecture that provides services to clients upon demand	
PLACEMENT QUESTIONS				
126.	Thingful		• Thingful is a search engine for the Internet of Things. • It allows secure interoperability between millions of IoT objects via the Internet. • This IOT testing tool also to control how data is used and empowers to take more decisive and valuable decisions.	
127.	Risks associated with IOE		1) Privacy, 2) Security, 3) Network congestion, and 4) Electricity consumption at the peaks.	
128.	main purpose of the Web of Things		• To improve the usability and interoperability in IoT. • Developing IoT Apps through WoT is much easier, faster, and less expensive.	
129.	IoT devises testing types		• Usability Testing • Compatibility Testing • Reliability and Scalability Testing • Data Integrity Testing • Security testing • Performance Testing	
130.	Device management		• Device identification • Configuration and control • Monitoring and diagnostics • Software updates and maintenance	
131.	Elements of IoT		• Smarter Devices in a different form • Network and Gateway that allows devices to be part of the IoT • Middleware that includes data storage spaces and advances predicting capabilities • End-user applications	

132.	IEEE standard of Bluethooth		IEEE 802.15	
133.	Data throughput speed of Bluethooth		721 Kbps	
134.	6LoWPAN Adaption layer contains?		• Header compression • Fragmentation • Layer 2 forwarding.	
135.	Industrial IoT		Category of IoT used for business to consumer process	
136.	Zigbee gateway		A ZigBee gateway is a means of transferring data between a ZigBee network and devices on another network.	
137.	Embedded operating system		A specialized operating system designed to perform a specific task for a device.	
138.	Number of masters and slaves in a piconet		One master and seven slaves	
139.	Zigbee		Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless IoT networks.	
140.	Range of Zigbee		ZigBee is widely used to control several devices within the range of **10–100 m**.	
141.	Number System		**If the number 481*673 is completely divisible by 9, what is the the smallest whole number in place of *?** **Soln:** => 4+8+1+x+6+7+3) is divisible by 9 => (29+x) is divisible by 9 x should be the smallest whole number. Hence, (29+x)=36 =>x=36−29=7 **Ans : 7**	
142.	Calendar		**Today is Monday. After 61 days, it will be** A. Sunday B. Saturday C. Monday D.Thursday **Soln** 61 days = 8 weeks 5 days = 5 odd days Hence if today is Monday, After 61 days, it will be = (Monday + 5 odd days) = Saturday **Ans :** C.Saturday	
143.	Profit and Loss		**Ramesh bought a chair for Rs. 1540 and sold it to Suresh. If Ramesh earned a profit of 25%, find the selling price of chair.** A. Rs.1875 B. Rs.1900 C.Rs.1925 D.Rs.1950 Soln: C.P. of the chair = Rs. 1540	

			S.P. of the chair =? Profit earned = 25% Selling Price =(100+Profit%) *C.P. 100 Therefore, S.P. =(100+25) *1540 100 =125/100 *1540=1925 Ans : C Rs.1925	
144.	Time and Distance		**A car running at a speed of 140 km/hr reached its destination in 2 hours. If the car wants to reach at its destination in 1 hour, at what speed it needs to travel?** A. 300 km/hr B. 280 km/hr C. 250 km/hr D. 240 km/hr **Soln:** Distance to be covered = Speed x Time = 140 * 2 = 280 km Time = 1 hour Required Speed = $^{280}/_{1}$= 280 km/hr **Ans: B.280 km/hr**	
145.	Pipes and Cisterns		**Two pipes can fill a tank in 6 hours and 8 hours respectively. A third pipe can empty the same tank in 12 hours. If all the pipes start working together, how long it will take to fill the tank?** A. 4 hours B.4.5 hours C.4.8 hours D.5.2 hours **Soln:** Part of the tank filled by two pipes in one hour = 1/6 + 1/8 Part of the tank emptied by the third pipe in one hour =1/12 Net part of the tank filled in one hour = 1/6+1/8-1/12= 5/24 5/24 Part of tank can be filled in one hour ∴ The whole tank will be filled in 24/5 = 4.8 hours **Ans: C. 4.8 hours**	
146.	Races & Games		**A can run 22.5 m while B runs 25 m. In a one kilometer race, B beats A by** A. 100 m B.111 1/9 m C.25 m D.50 m Soln: When B runs 25 m, A runs 45/2 m When B runs 1000 m, A runs (45/2 * 1/25 * 1000)=900m ∴ B beats A by 100 m. Ans: A. 100 m	
147.	Alligation and Mixture		**A 20 liter mixture contains 30% alcohol and 70% water. If 5 liters of water is added to the mixture, what will be the percentage of alcohol in the new mixture?** A. 22% B.23% C.24% D.25% Soln:	

			Initially, the mixture contains 30% alcohol = 30/100 ∗20=6 liters of alchol And, 70% of water = 70/100 ∗20=14 liters of water After adding 5 liters of water, the mixture contains (14+5) 19 liters of water and 6 liters of alcohol. ∴Percentage of alcohol = 6/25∗100=24% **Ans: C. 24%**	
148.	Logical Reasoning		**SCD, TEF, UGH, ____, WKL** A.CMN B.UJI C.VIJ D. IJT **Soln:** There are two alphabetical series here. The first series is with the first letters only: STUVW. The second series involves the remaining letters: CD, EF, GH, IJ, KL. **Ans: C.** VIJ	
149.	Logical Reasoning		**Which word does NOT belong with the others?** A. Tulip B. Rose C. Bud D.Daisy Tulip, rose, and daisy are all types of flowers. A bud is not. **Ans: C. Bud**	
150.	Logical Reasoning		**Find the next number in the sequence:** **3, 6, 9, 30, 117.....** A. 192 B. 352 C. 388 D. 588 Soln: 3 * 1 + 3 = 6 6 * 2 – 3 = 9 9 * 3 + 3 = 30 30 * 4 – 3 = 117 117 * 5 + 3 = 588 Ans. D 588	

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HOD