THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**Semester**	3rd/5th	0.6
Course name / Module	PCB Designing and Manufacturing		
Course code	ITN1111		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

1) For carbon resistors what is the color for 5?
(A) Green (B) Black
(C) Orange (D) Gray.

2) The four stripes of a resistor are yellow-violet-orange-gold. The value of resistor should be
(A) 470 ohms ± 5 % (B) 47 kilo ohm ± 5%
(C) 47 mega ohms ± 5% (D) 4700 ohms ± 10%

3) The tolerance for silver stripe is
(A) +5% (B) + 10%
(C) ± 5% (D) ± 10%.

4) Which of the following carbon coded resistor has value of 10 K-ohm with 20% tolerance?
(A) Red, red, green and silver stripes
(B) Yellow, violet, yellow and silver stripes
(C) Orange, orange, black and gold stripes
(D) Brown, black, orange and no tolerance band.

5) What is the unit of capacitance?
A) henry B) farad
C) ohm D) none

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

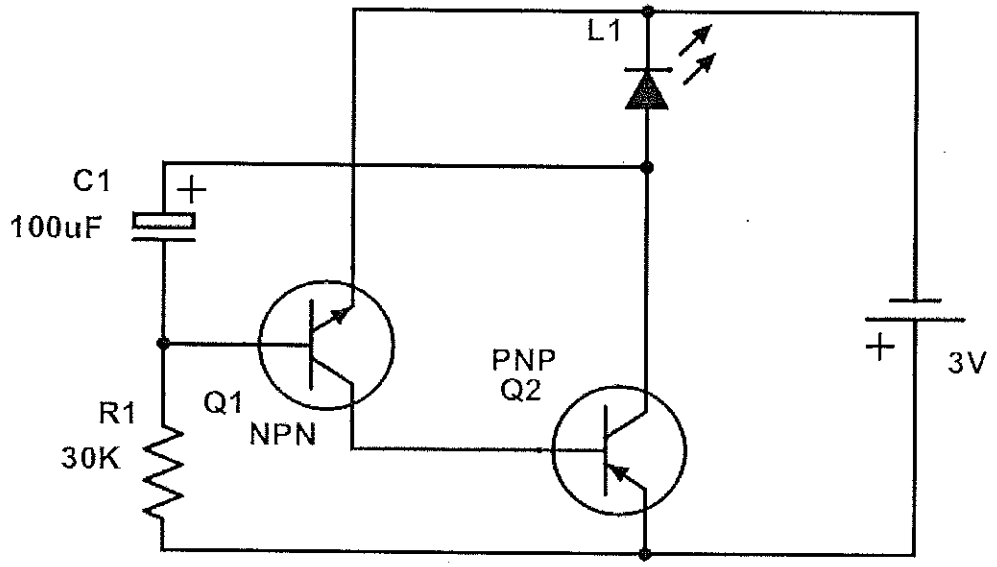
1. What is the difference between active and passive components?

2. What are the classification of capacitors? Write just names.

3. What is the difference between transistor and MOSFET?

3. Section C	09

1. Design single sided PCB layout of the given circuit.



Note: Marks distribution

1	Schematic design	1 Mark
2	Component value assignment	1 Mark
3	Electric rules check and correction	1 Mark
4	Netlist generation	1 Mark
5	Footprint assignment	2 Marks
6	PCB layout design	2 Marks
7	Gerber file generation	1 Mark
	Total	**9 Marks**

PRACTICAL1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc	Semester	
Course name / Module	OE-(3D Printing)		
Course code	ITN1110		
Date			
Name of the Student		Reg. No.	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

Section A	05×1 = 05

Q1. Which one of the following is the correct dimension of SLA 3D Printer build volume size?

a) 128mm X138mm X 143mm
b) 128mm X128mm X 300mm
c) 128mm X128mm X 200mm
d) None of the above

2. Which one of the following is the correct dimension of MAX500 FDM 3D Printer build volume size?

a) 400mm X 300mm X 500mm
b) 500mmX500mm X 300mm
c) 500mm X 500mm X 500mm
d) 300mmX400mm X 300mm

3. Which one of the following is the correct dimension of Da Vinci 3D Printer build volume size?

a) 290mm X 290mm X 300mm
b) 350mm X300mm X 300mm
c) 350mm X 350mm X 350mm
d) None of the above

4. Which one of the following is the correct dimension of MAX300 FDM 3D printer build volume size?

a) 300mm X200m X 140mm
b) 300mmX300mm X 300mm
c) 300mm X300mm X 500mm
d) 350mm X300mm X 300mm

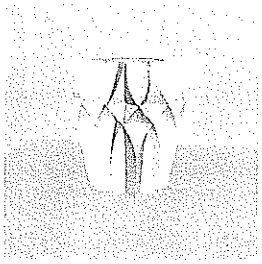
5. Which one of the following is the correct dimension of AHA FDM 3D Printer build volume size?

a) 230mm X 230mm X 230mm
b) 128mm X230mm X 230mm
c) 128mm X 230mm X 200mm
d) 300mmX200mm X 300mm

Section B	06 Marks

Q1. Print the single colour file given below on FDM MAX300 3D Printer, as instructed by the examiner.

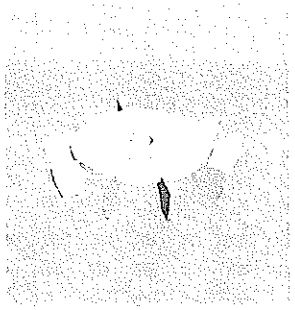
a) **Add machine in slicing software**
b) **Add all parameters in slicing software**
c) **Use material ABS**
d) **Save Code**



Section C	09 Marks

Q1. Print the single colour file given below on FDM MAX500 Printer, as instructed by the examiner.

a) **Add machine in slicing software**
b) **Add all parameters in slicing software**
c) **Use material PLA**
d) **Save Code**



THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc **Semester**	1st/3rd/5th	
Course name / Module	Robotics Open Elective		
Course code	ITN1113		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

1. Section A (04 short answer type questions, each question carries 03 marks)	**04×03 = 12**

Q1.What is Drive?

Q2. What is End-Effector?

Q3. Define Proximity Sensors.

Q4. Define Velocity Sensors.

2. Section B (01 long type question carrying 8 marks	**01×08 = 08**

Q1. Write a program using ABB Robot to Pick a block from Table 1 and place it on Table 2.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**B.Voc** **Semester**	3rd	
Course name / Module	Basics of Network Security		
Course code	ITN1303		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20** • Duration of Examination: **01 Hour** • Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

1. Which is not an objective of network security.

a) Identification

b) Authentication

c) Access control

d) Lock

2. Which of these is a part of network identification.

a) UserID

b) Password

c) OTP

d) fingerprint

3. The process of verifying the identity of a user.

a) Authentication

b) Identification

c) Validation

d) Verification

4. A concern of authentication that deals with user rights.

a) General access

b) Functional authentication

c) Functional authorization

d) Auto verification

5.What is full form of VIRUS .

a) Vitalise Information Resources Under Siege

b) Vital Informational Resources Under Siege

c) Vital Information Resources Under Siege

d) Vital Information Resources Undead Siege

2. **Section B** (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q.1 Explain CIA .
Q.2 Explain why network security is important .
Q.3 Explain black hat , white hat & grey hat hacker .

3. **Section C** (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q.1 Explain types of malware .
Q.2 What is computer Virus explain with example (any 3) .
Q.3 What is trojan horse malware explain with example (any 3) .

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc	**B.Voc** **Semester**	3rd	
Course name / Module	Wireless Networks		
Course code	~~1302~~ 1TN1302		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20** • Duration of Examination: **01 Hour** • Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

Q1. What is wireless communication?

a) Sending data from one location to with the use of physical medium

b) Sending data from one location to another without the use of physical medium

c) Sending data from one location to another without the use of virtual medium

d) None of the mentioned

Q2. Which of the following is not an example of wireless communication?

a) Wi-Fi

b) Mobiles

c) Landline

d) Bluetooth

Q3. Which of the following specifies a set of media access control (MAC) and physical layer specifications for implementing WLANs?

a) IEEE 802.11

b) IEEE 802.16

c) IEEE 802.15

d) IEEE 802.3

Q4. Which of the following do not undergo free space propagation?

a) Wired telephone systems

b) Wireless line of sight radio links

c) Microwave line of sight radio links

d) Satellite communication system

Q5. What are the two modes of WLAN?

a) Infrastructure and Adhoc.

b) Adhoc and wireless

c) Infrastructure and wireless

d) Wireless and Wired

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q1. What are two types of coaxial cables used in point to point links and which one has more loss?

Q2. What is free space loss (FSL). Write the formula for the same?

Q3. Explain Omini and Directional antennas.

3. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q1. The access point is connected to an antenna with 10dBi gain, with a transmitting power of 20 dBm and a receive sensitivity of -89 dBm. The client is connected to an antenna with 14 dBi gain, with a Tx power of 15 dBm and a Rx sensitivity of -82 dBm. The cables in both systems are short with a loss of 2 dB at each side at 2.4 GHz. The link distance is 5 Km. Calculate the link budget from AP to Client and Client to AP.

Q2. Write down advantages of the wireless networks over wired networks.

Q3. Write some examples for wireless communication systems.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc **Semester**	5th	
Course name / Module	Deep Learning and Neural Networks		
Course code	MAI1501		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20** • Duration of Examination: **01 Hour** • Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

Q1. The general structure of Artificial Neural network has the following layers:
a. Input Layer
b. Output Layer
c. Hidden Layer
d. All of the Above

Q2. Which one of the following is not a type of Activation Function?
a. Relu Function
b. Sigmoid Function
c. Step Function
d. Neural Function

Q3. CNN Stands for:
a. Convolutional Neural Network
b. Controlled Neural Network
c. Convolutional Natural Network
d. None of the Above

Q4. A neural Network is considered Deep depending on the number of:
a. Input Layer
b. Output Layer
c. Hidden Layer
d. None of the Above

Q5. RNN Stands for:
a. Reinforced Neural Network
b. Reinforced Natural Network
c. Recurrent Neural Network
d. None of the Above

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q1. Write short notes on Restricted Boltzman Networks.

Q2. Write short notes on Deep Belief Networks.

Q3. Write short notes on Generative Adversarial Networks.

3. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q1. Explain Convolution Neural Networks in detail.

Q2. Explain the meaning of the term "Training a Neural Network" using Gradient Descent Optimization Technique.

Q3. What is Activation Function? Explain the different types of Activation functions.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**Semester**	5th	
Course name / Module	Internet of Things (IoT)		
Course code	ITN1504		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

1. Which of the following category is used for business to consumer process?
   A) Industrial IoT B) Group IoT
   C) Community IoT D) Personal IoT

2. Which is the future application of IoT?
   A) QoS in communication B) Secure communication
   C) Multimedia communication D) Role of green IoT system

3. In IoT, most common application for voice control application are _____
   A) Home security and health monitoring B) Home security
   C) Family health monitoring D) Business

4. Which of the following issues are considered in IoT?
   A) Security Issue B) Reliability Issue
   C) Standard Issue D) All issues

5. Voice recognition software and virtual assistant programs offer for _____ and _____
   A) Communication B) Entertainment
   C) Communication and Software D) Communication and Entertainment

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

1. What is the need for IoT?
2. What are the different categories of IoT?
3. What is IoT and how it works?

2. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

1. Why IoT is important for the business world today?
2. What is Wireless Sensor Network? Just brief its challenges and applications.
3. What kind of sensors are used in IoT? Explain.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc	Semester	3rd
Course name / Module	Optical Fiber Communication		
Course code	ITN1305		
Date			
Name of the Student		Reg. No.	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

Section A	05×1 = 05

Q1. Which of the following is the principle of operation of fiber- optic cable?

a) Absorption
b) Distortion
c) Dispersion
d) Reflection

Q2. Which fiber is preferred for long distance communication?

a) Step index single mode fiber
b) Step index multimode fiber
c) Graded index multimode fiber
d) Graded index fiber

Q3. In optical fiber communications, the signal source is _____ waves.

a) Light
b) Infrared
c) Radio
d) Very low- frequency

Q4. In optical fiber, the inner layer is _____ and outer layer is _____ .

a) Core, Cladding
b) Reflect, Transmit
c) Transmit, Reflect
d) Cladding, Core

Q5. Optical Splice provides a connection between.

a) Transmitter to fiber
b) fiber to fiber
c) Receiber to fiber
d) fiber to repeater

Section B	03×02 = 06

Q1. What is core and cladding in optical fibers explain with diagram.

Q2. Write the short note on Fusion splice and Mechanical splice.

Q3. Write a short note on patch cord and pig tails.

Section C	03×03 = 09

Q1. What are the advantages & disadvantage of optical fiber?

Q2. What is the principle of OTDR? Explain.

Q3. What are the types of Optic fiber connectors?

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc **Semester**	5th	
Course name / Module	Reinforcement Learning		
Course code	MAI1502		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

Q1. Reinforcement Learning is one of the major components of Machine Learning. What are the other two components?

a. Supervised Learning and Unsupervised Learning
b. Supervised Learning and Deep Learning
c. Unsupervised Learning and Deep Learning
d. None of the above

Q2. Which of the components of Machine Learning works on data from the dynamic environment?

a. Supervised Learning
b. Unsupervised Learning
c. Reinforcement Learning
d. None of the Above

Q3. Reinforcement Learning works by allowing a piece of Software to explore, interact with and learn from the environment. This Software is called?

a. Agent
b. Neural Network
c. Model
d. None of the Above

Q4. Which function in Reinforcement Learning takes in state observations (the inputs) and mpas them into actions (the outputs)

a. Agent
b. Policy
c. Model
d. None of the Above

Q5. The term given to the process of systematically adjusting a set of parameters that will produce an optimal policy is called?

a. Learning
b. Knowledge Enhancement
c. Trial and Error
d. None of the Above

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q1. Implement One Hot Encoding using Python on the following Data:

Country	Age	Salary	Purchased
France	44	72000	No
Spain	27	48000	Yes
Germany	30	54000	No
Spain	38	61000	No
Germany	40		Yes
France	35	58000	Yes
Spain		52000	No
France	48	79000	Yes
Germany	50	83000	No
France	37	67000	Yes

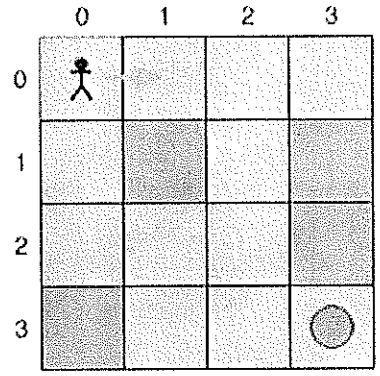
Q2. Replace the missing values with the Column Average using Python on the following data:

Country	Age	Salary	Purchased
France	44	72000	No
Spain	27	48000	Yes
Germany	30	54000	No
Spain	38	61000	No
Germany	40		Yes
France	35	58000	Yes
Spain		52000	No
France	48	79000	Yes
Germany	50	83000	No
France	37	67000	Yes

Q3. Describe the process of Reinforcement Learning.

3. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q1. Solve the Frozen Lake problem using the fundamental concepts of Reinforcement Learning.



Legends:

A thick and safe layer of ice which you can walk over

A hole in the ice. Fall here and you're dead

The frisbee. Be the hero and get it back

You

Q2. Explain the Cross Entropy Method for Machine Learning.

Q3. Explain the Markov Decision Process (MDP).

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**B.Voc**	**Semester**	5th
Course name / Module	Natural Language Processing (NLP)		
Course code	MAI-1504		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

A. NLP is concerned with the interactions between computers and human (natural) languages.

a. Yes
b. No
c. Not Sure
d. All of the Above

B. The following areas where NLP can be useful -

a. Automatic Text Summarization
b. Information Retrieval
c. Automatic Question-Answering Systems
d. All of the Above

C. One of the main challenge/s of NLP is _____ .

a. Handling Tokenization
b. Handling Ambiguity of Sentences
c. Handling POS-Tagging
d. All of the above

D. Natural language processing is divided into the two subfields of -

a. symbolic and numeric
b. algorithmic and heuristic
c. time and motion
d. understanding and generation

b) E. Natural language processing (nlp) is associated with which of the following areas?

a. text mining
b. artificial intelligence
c. computational linguistics
d. All of the above

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q1. Differentiate between structured and unstructured data.
Q2. What is parsing in NLP?
Q3. What do you understand by tokenization and stopwords?

3. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q1. Explain any two components of NLP. What is parta of speech (POS)?
Q2. Give one example of Natural language generation NLG and NLP.
Q3. Analyze and explain syntax and symantics in NLP.

BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Computing Skills

Session: 2022-23 (Summer Semester)

B. Voc. Program, 5th Semester,

1st In-Sem. Examination

ANSWER KEY

Course Code: MAI1501

Course Name: Deep Learning and Neural Networks

Section – A

Q1. Answer - d

Q2. Answer - d

Q3. Answer - a

Q4. Answer - c

Q5. Answer - c

Section – B

Q1. Answer -

In 2006, a breakthrough was achieved in tackling the issue of vanishing gradients. Geoff Hinton devised a novel strategy that led to the development of Restrictred Boltzman Machine - RBM, a shallow two layer net.

The first layer is the visible layer and the second layer is the hidden layer. Each node in the visible layer is connected to every node in the hidden layer. The network is known as restricted as no two layers within the same layer are allowed to share a connection.

Autoencoders are networks that encode input data as vectors. They create a hidden, or compressed, representation of the raw data. The vectors are useful in dimensionality reduction; the vector compresses the raw data into smaller number of essential dimensions. Autoencoders are paired with decoders, which allows the reconstruction of input data based on its hidden representation.

RBM is the mathematical equivalent of a two-way translator. A forward pass takes inputs and translates them into a set of numbers that encodes the inputs. A backward pass meanwhile takes this set of numbers and translates them back into reconstructed inputs. A well-trained net performs back prop with a high degree of accuracy. In either steps, the weights and the biases have a critical role; they help the RBM in decoding the interrelationships between the inputs and in deciding which inputs are essential in detecting patterns. Through forward and backward passes, the RBM is trained to re-construct the input with different weights and biases until the input and there-construction are as close as possible. An interesting aspect of RBM is that data need not be labelled. This turns out to be very important for real world data sets like photos, videos, voices and sensor data, all of which tend to be unlabelled. Instead of manually labelling data by humans, RBM automatically sorts through data; by properly adjusting the weights and biases, an RBM is able to extract important features and reconstruct the input. RBM is a part of family of feature extractor neural nets, which are designed to recognize inherent patterns in data. These are also called auto-encoders because they have to encode their own structure.

Q2. Answer -

Deep belief networks (DBNs) are formed by combining RBMs and introducing a clever training method. We have a new model that finally solves the problem of vanishing gradient. Geoff Hinton invented the RBMs and also Deep Belief Nets as alternative to back propagation.

A DBN is similar in structure to a MLP (Multi-layer perceptron), but very different when it comes to training. it is the training that enables DBNs to outperform their shallow counterparts

A DBN can be visualized as a stack of RBMs where the hidden layer of one RBM is the visible layer of the RBM above it. The first RBM is trained to reconstruct its input as accurately as possible.

The hidden layer of the first RBM is taken as the visible layer of the second RBM and the second RBM is trained using the outputs from the first RBM. This process is iterated till every layer in the network is trained.

In a DBN, each RBM learns the entire input. A DBN works globally by fine-tuning the entire input in succession as the model slowly improves like a camera lens slowly focussing a picture. A stack of RBMs outperforms a single RBM as a multi-layer perceptron MLP outperforms a single perceptron.

At this stage, the RBMs have detected inherent patterns in the data but without any names or label. To finish training of the DBN, we have to introduce labels to the patterns and fine tune the net with supervised learning.

We need a very small set of labelled samples so that the features and patterns can be associated with a name. This small-labelled set of data is used for training. This set of labelled data can be very small when compared to the original data set.

The weights and biases are altered slightly, resulting in a small change in the net's perception of the patterns and often a small increase in the total accuracy. The training can also be completed in a reasonableamount of time by using GPUs giving very accurate results as compared to shallow nets and we see a solution to vanishing gradient problem too.

Q3. Answer -

Generative adversarial networks are deep neural nets comprising two nets, pitted one against the other, thus the "adversarial" name. GANs were introduced in a paper published by researchers at the University of Montreal in 2014. GANs' potential is huge, as the networkscan learn to mimic any distribution of data. GANs can be taught to create parallel worlds strikingly similar to our own in any domain: images, music, speech, prose. They are robot artists in a way, and their output is quite impressive. In a GAN, one neural network, known as the generator, generates new data instances, while the other, the discriminator, evaluates them for authenticity.

Let us say we are trying to generate hand-written numerals like those found in the MNIST dataset, which is taken from the real world. The work of the discriminator, when shown an instance from the true MNIST dataset, is to recognize them as authentic. Now consider the following steps of the GAN:

- The generator network takes input in the form of random numbers and returns an image.
- This generated image is given as input to the discriminator network along with a stream of images taken from the actual dataset.
- The discriminator takes in both real and fake images and returns probabilities, a number between 0 and 1, with 1 representing a prediction of authenticity and 0 representing fake.
- So you have a double feedback loop:
    - o The discriminator is in a feedback loop with the ground truth of the images, which we know.
    - o The generator is in a feedback loop with the discriminator.

Section – C

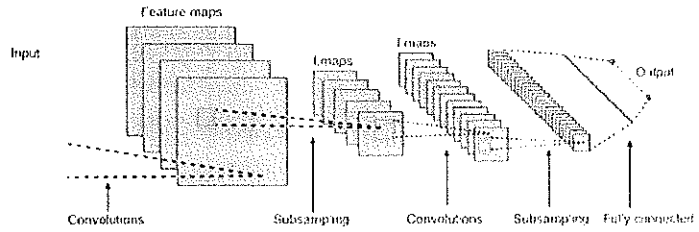
Q1. Answer -

If we increase the number of layers in a neural network to make it deeper, it increases the complexity of the network and allows us to model functions that are more complicated. However, the number of weights and biases will exponentially increase. As a matter of fact, learning such difficult problems can become impossible for normal neural networks. This leads to a solution, the convolutional neural networks.

CNNs are extensively used in computer vision; have been applied also in acoustic modeling for automatic speech recognition. The idea behind convolutional neural networks is the idea of a "moving filter" which passes through the image. This moving filter, or convolution, applies to a certain neighbourhood of nodes which for example may be pixels, where the filter applied is 0.5 x the node value:

Noted researcher Yann LeCun pioneered convolutional neural networks.Facebook as facial recognition software uses these nets. CNN have been the go to solution for machine vision

projects. There are many layers to a convolutional network. In Imagenet challenge, a machine was able to beat a human at object recognition in 2015. In a nutshell, Convolutional Neural Networks (CNNs) are multi-layer neural networks. The layers are sometimes upto 17 or more and assume the input data to be images.



Q2. Answer -

We have to find the optimal values of the weights of a neural network to get the desired output. To train a neural network, we use the iterative gradient descent method. We start initially with random initialization of the weights. After random initialization, we make predictions on some subset of the data with forward-propagation process, compute the corresponding cost function C, and update each weight w by an amount proportional to dC/dw, i.e., the derivative of the cost functions w.r.t. the weight. The proportionality constant is known as the learning rate.

The gradients can be calculated efficiently using the back-propagation algorithm. The key observation of backward propagation or backward prop is that because of the chain rule of differentiation, the gradient at each neuron in the neural network can be calculated using the gradient at the neurons, it has outgoing edges to. Hence, we calculate the gradients backwards, i.e., first calculate the gradients of the output layer, then the top-most hidden layer, followed by the preceding hidden layer, and so on, ending at the input layer.

The back-propagation algorithm is implemented mostly using the idea of a computational graph, where each neuron is expanded to many nodes in the computational graph and performs a simple mathematical operation like addition, multiplication. The computational graph does not have any weights on the edges; all weights are assigned to the nodes, so the weights become their own nodes. The backward propagation algorithm is then run on the computational graph. Once the calculation is complete, only the gradients of the weight nodes are required for update. The rest of the gradients can be discarded.

Gradient Descent Optimization Technique

One commonly used optimization function that adjusts weights according to the error they caused is called the "gradient descent." Gradient is another name for slope, and slope, on an x-y graph, represents how two variables are related to each other: the rise over the run, the change in distance over the change in time, etc. In this case, the slope is the ratio between the network's error and a single weight; i.e., how does the error change as the weight is varied.

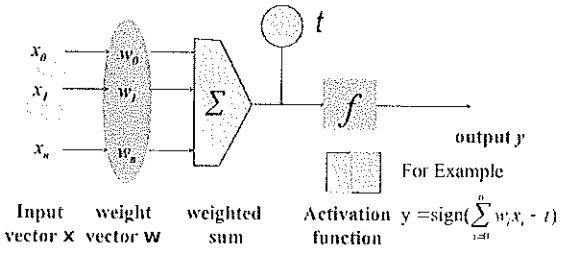
To put it more precisely, we want to find which weight produces the least error. We want to find the weight that correctly represents the signals contained in the input data, and translates them to a correct classification.

As a neural network learns, it slowly adjusts many weights so that they can map signal to meaning correctly. The ratio between network Error and each of those weights is a derivative, dE/dw that calculates the extent to which a slight change in a weight causes a slight change in the error.

Each weight is just one factor in a deep network that involves many transforms; the signal of the weight passes through activations and sums over several layers, so we use the chain rule of calculus to work back through the network activations and outputs.This leads us to the weight in question, and its relationship to overall error. Given two variables, error and weight, are mediated by a third variable, activation, through which the weight is passed. We can calculate how a change in weight affects a change in error by first calculating how a change in activation affects a change in Error, and how a change in weight affects a change in activation.

The basic idea in deep learning is nothing more than that: adjusting a model's weights in response to the error it produces, until you cannot reduce the error any more. The deep net trains slowly if the gradient value is small and fast if the value is high. Any inaccuracies in training leads to inaccurate outputs. The process of training the nets from the output back to the input is called backpropagation or back prop. We know that forward propagation starts with the input and works forward. Back prop does the reverse/opposite calculating the gradient from right to left. Each time we calculate a gradient, we use all the previous gradients up to that point. Let us start at a node in the output layer. The edge uses the gradient at that node. As we go back into the hidden layers, it gets more complex. The product of two numbers between 0 and 1 gives you a smaller number. The gradient value keeps getting smaller and as a result back prop takes a lot of time to train and accuracy suffers.

Q3. Answer -



ACTIVATION FUNCTION

- A function that transforms the values or states the conditions for the decision of the output neuron is known as an **activation function.**
- What does an artificial neuron do? Simply, it calculates a "weighted sum" of its input, adds a bias and then decides whether it should be "fired" or not.
- So consider a neuron.

$$Y = \sum (weight * input) + bias$$

ACTIVATION FUNCTION

- The value of Y can be anything ranging from -inf to +inf. The neuron really doesn't know the bounds of the value. So how do we decide whether the neuron should fire or not (why this firing pattern? Because we learnt it from biology that's the way brain works and brain is a working testimony of an awesome and intelligent system).
- We decided to add "activation functions" for this purpose. To check the Y value produced by a neuron and decide whether outside connections should consider this neuron as "fired" or not. Or rather let's say—"activated" or not.

ACTIVATION FUNCTION

- ***Activation functions*** are really important for a Artificial Neural Network to learn and make sense of something really complicated and non-linear complex functional mappings between the inputs and response variable. They introduce non-linear properties to our network.
- **Their main purpose is to convert an input signal of a node in a A-NN to an output signal.** That output signal now is used as a input in the next layer in the stack.

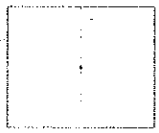
TYPES OF ACTIVATION FUNCTIONS

Step function

•Activation function A = "activated" if Y > threshold else not

•Alternatively, A = 1 if Y > threshold, 0 otherwise

•Well, what we just did is a "step function", see the below figure.

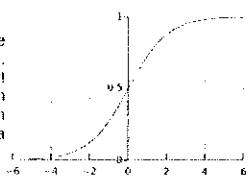


TYPES OF ACTIVATION FUNCTIONS

Sigmoid function

$$A = \frac{1}{1+e^{-x}}$$

This looks smooth and "step function like". What are the benefits of this? It is nonlinear in nature. Combinations of this function are also nonlinear! Great. Now we can stack layers. What about non binary activations? Yes, that too! It will give an analog activation unlike step function. It has a smooth gradient too.



TYPES OF ACTIVATION FUNCTIONS

Tanh Function

•Another activation function that is used is the tanh function.

$$f(x) = tanh(x) = \frac{2}{1+e^{-2x}} - 1$$

This looks very similar to sigmoid.
In fact, it is a scaled sigmoid function!

$$tanh(x) = 2\,sigmoid(2x) - 1$$

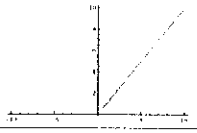
TYPES OF ACTIVATION FUNCTIONS

ReLu

•Later, comes the ReLu function,

A(x) = max(0,x)

The ReLu function is as shown above. It gives an output x if x is positive and 0 otherwise.



BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Computing Skills

Session: 2022-23 (Summer Semester)

B. Voc. Program, 5th Semester,

1st In-Sem. Examination

ANSWER KEY

Course Code: MAI1502

Course Name: Reinforcement Learning

Section – A

05X01 = 05 Marks

Q1. Answer - a

Q2. Answer - c

Q3. Answer - a

Q4. Answer - b

Q5. Answer - a

Section – B

03X02 = 06 Marks

Q1. Answer.

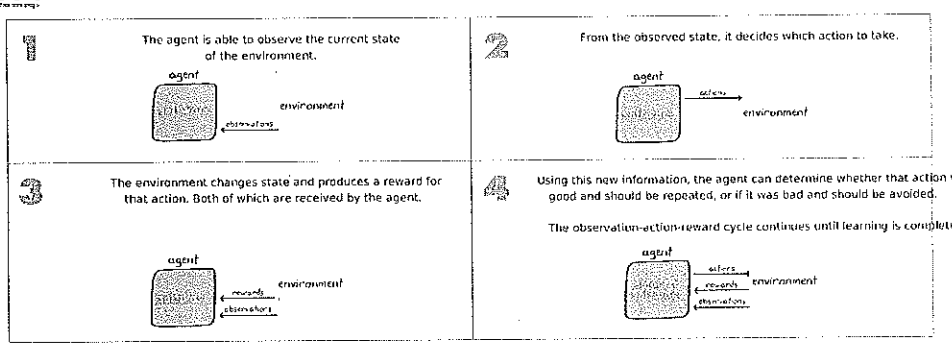
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
dataset = pd.read_csv('Data.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, -1].values
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
ct = ColumnTransformer(transformers=[('encoder', OneHotEncoder(), [0])], remainder='passthrough')
X = np.array(ct.fit_transform(X))
```

Q2. Answer.

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
dataset = pd.read_csv('Data.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, -1].values
from sklearn.impute import SimpleImputer
imputer = SimpleImputer(missing_values=np.nan, strategy='mean')
imputer.fit(X[:, 1:3])
X[:, 1:3] = imputer.transform(X[:, 1:3])
```

Q3. Answer.

RL works with data from a dynamic environment. And the goal is not to cluster data or label data, but to find the best sequence of actions that will generate the optimal outcome. The way reinforcement learning solves this problem is by allowing a piece of software called an agent to explore, interact with, and learn from the environment.

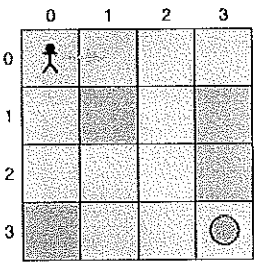


Section – C

03X03 = 09 Marks

Q1. Answer

Let's understand how Reinforcement Learning works through a simple example. Let's play a game called The Frozen Lake. Suppose you were playing frisbee with your friends in a park during winter. One of you threw the frisbee so far that it has dropped in a frozen lake. Your mission is to walk over the frozen lake to get the frisbee back, but taking caution to not fall in a hole of freezing water.



Legends:

A thick and safe layer of ice which you can walk over

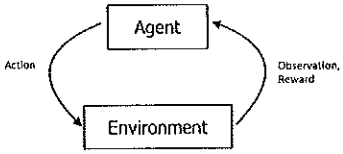
A hole in the ice. Fall here and you're dead

The frisbee. Be the hero and get it back

You

We could easily create a bot that always wins this game by writing a simple algorithm giving the right directions to reach the frisbee. But that's not challenging or fun at all. Instead, we want to create an agent that can learn the path to the frisbee while playing the game multiples times.

In the reinforcement learning paradigm, the learning process is a loop in which the agent reads the state of the environment and then executes an action. Then the environment returns its new state and a reward signal, indicating if the action was correct or not. The process continues until the environment reaches a terminal state or if a maximum number of iterations is executed.



Therefore, the first step to train our agent to play the Frozen Lake game is to model each aspect of the game as components of a reinforcement learning problem.

The Environment

The environment is a representation of the context that our agent will interact with. It can represent an aspect of the real world, like the stock market, or a street for example, or it can be a completely virtual environment, like a game. In either case, the environment defines the states and rewards the agent can receive as well as the

possible actions that the agent can execute for each state. In our case, the environment is the Frozen Lake game, which consists of a grid of squares that can be of two types:

- Grey squares, representing a safe thick layer of ice that you can walk over.
  Blue squares, representing holes in the ice.

- The hero can move in four directions (up, down, right, left) inside the grid. If you reach the frisbee you win the game, but you lose if you fall into a hole.

State

States are observations that the agent receives from the environment. It's the way the agent receives all available information about the environment. In our example, the state of the game is simply the position of the character in the grid, which will be represented by a pair of coordinates (i, j).

Actions

Actions are performed by the agent and may change the state of the environment. All the rules of how an action changes the state of the environment are internal to the environment. For a given state, the agent can choose which will be its next action, but it does not have any control over how this action will affect the environment. For the Frozen Lake example, the available actions to the agent are the four directions to which our hero can move: up, right, down and left.

Rewards

Rewards signal to the agent if an action was correct or not. In our example, the environment returns +1 when the hero reaches the frisbee or -1 if the hero falls into a hole. Every other cases are considered neutral, so the environment returns 0 (zero).

The Gameplay

The game starts with the hero at the position (0, 0). From this state, there are two possible actions, moving right or moving down. If the agent chooses to move to the right, then the new state will be (0,1) and the agent will receive a reward of 0 (zero) because it's a neutral play. From the position (0, 1) there are three possible moves: left, right and down. Supposing the agent chooses to move down, then the new state will be the position (1, 1). However, this position is a hole in the ice, which means the agent lost the game. So the agent receives an -1 penalty and the game is over. This sequence is shown at the table below:

Current state	Action	Next State	Reward	Game over?
(0, 0)	→	(0, 1)	0	No
(0, 1)	↓	(1, 1)	-1	Yes

Another possible sequence from the state (0, 1) is the hero moves to the right and reaches the state (0, 2). From there, the hero keeps moving until it reaches the position (3, 2) and finally it moves to the left, reaching the frisbee at the position (3, 3) and receiving a +1 reward.

Current state	Action	Next State	Reward	Game over?
(0, 0)	→	(0, 1)	0	No
(0, 1)	→	(0, 2)	0	No
(0, 2)	→	(1, 2)	0	No
(1, 2)	→	(2, 2)	0	No
(2, 2)	→	(3, 2)	0	No
(3, 2)	→	(3, 3)	+1	Yes

Q2. Answer

What is Cross-Entropy Method?

From a biological viewpoint, it is an *Evolutionary Algorithm.* Some individuals are sampled from a population and only the best ones govern the characteristics of future generations.

Mathematically, it can be seen as a *Derivative-Free Optimization* (DFO) technique, i.e., it can find optima without the overhead of calculating derivatives (no backpropagation!).

How does this method work?

Assume for a second that you do not know what are agents, environments, and policies. You are just given a "black-box" which takes some numbers as inputs and outputs some other numbers. You can only choose the values for your inputs and observe the outputs. *How do you guess the inputs such that the outputs are the values you want?*

One simple way of doing this would be to take a bunch of inputs, see the outputs produced, choose the inputs that have led to the best outputs and tune them till you are satisfied with the outputs you see. This is essentially what the cross-entropy method does.

So, how do I use it to solve my RL problem?

Let's understand the working of CEM step-by-step with an example. I have added some python code snippets with each step for a better understanding of the implementation. The code is heavily borrowed from Udacity's course on Deep Reinforcement Learning (amazing python RL resources btw, Github link at the end of this article)[1].

Consider your policy network. You want to find the best weights which can take the right "meaningful" actions based on your agent's state. A CEM-based approach for finding these weights is as follows:

Step 1: Draw a bunch of initial weights from a random distribution. Although this distribution is generally chosen to be Gaussian, you can choose any distribution that you believe the weights are from. Let's say I drew 10 candidates for weights w1, w2, ..., w10 from a Gaussian distribution with mean μ and variance σ^2.

Consider μ=0, σ=1, n_weights=10 (number of candidates) and weights_dim represents dimensions of the weight vector.

mean = 0.0

std = 1.0

n_weights = 10weights_pop = [mean + std*np.random.randn(weights_dim) for i_weight in range(n_weights)]

Step 2: Now let the agent pick actions from the policy network based on these weights, run the agent through an episode and collect the rewards generated by the environment. For our example, say w1 generates a cumulative reward r1, w2 generates r2 and so on.

The evaluate method for an agent takes a weight candidate as input, plays an episode and outputs the cumulative reward from that episode.

```
rewards = [agent.evaluate(weights) for weights in weights_pop]
```

Step 3: Find the weights which generated the best rewards. Assume the best 4 weights were w1, w2, w5 and w6 (also called the "elite" weights). Here 4 is a number that we have chosen. In general, you consider best n weights, where n is chosen by you.

```
n_elite = 4

elite_idxs = np.array(rewards).argsort()[-n_elite:] elite_weights =
[weights_pop[idx] for idx in elite_idxs]
```

Step 4: Pick the new weights from a distribution defined by the *elite* weights. Say μ' is the mean of the best weights (w1, w2, w5 and w6) and σ'^2 is their variance. We now draw 10 candidates from a gaussian distribution with mean μ' and variance σ'^2.

```
mean = np.array(elite_weights).mean()

std = np.array(elite_weights).std()weights_pop = [mean +
std*np.random.randn(weights_dim) for i_weight in range(n_weights)]
```

Step 5: Repeat steps 2–4 until you are happy with the rewards you get.

If python code is not your thing and you love to read algorithms with math jargon, here is the pseudocode for you[2]:

Initialize $\mu \in \mathbb{R}^d, \sigma \in \mathbb{R}^d$
for iteration $= 1, 2, \ldots$ **do**
  Collect n samples of $\theta_i \sim N(\mu, \text{diag}(\sigma))$
  Perform a noisy evaluation $R_i \sim \theta_i$
  Select the top $p\%$ of samples (e.g. $p = 20$), which we'll
    call the **elite set**
  Fit a Gaussian distribution, with diagonal covariance,
    to the elite set, obtaining a new μ, σ.
end for
Return the final μ.

Q3. Answer

Terminology

First things first, before even starting with MDPs, we'll quickly glance through the terminology that will be used throughout this article:

1. **Agent:** An RL agent is the entity which we are training to make correct decisions (for eg: a Robot that is being trained to move around a house without crashing).

2. **Environment:** The environment is the surrounding with which the agent interacts (for eg: the house where the Robot moves). The agent cannot manipulate the environment; it can only control its own actions (for eg: the Robot cannot control where a table is kept in

the house, but it can walk around it to avoid crashing).

3. **State:** The state defines the current situation of the agent (for eg: it can be the exact position of the Robot in the house, or the alignment of its two legs, or its current posture; it depends on how you address the problem).

4. **Action:** The choice that the agent makes at the current time step (for eg: it can move its right or left leg, or raise its arm, or lift an object, turn right or left, etc.). We know the set of actions (decisions) that the agent can perform in advance.

5. **Policy:** A policy is the thought process behind picking an action. In practice, it is a probability distribution assigned to the set of actions. Highly rewarding actions will have a high probability and vice versa.

Note that if an action has a low probability, it doesn't mean it won't be picked at all. Just that it is less likely to be picked.

Markov Property

A state S_t is *Markov* if and only if

$$\mathbb{P}[S_{t+1} \mid S_t] = \mathbb{P}[S_{t+1} \mid S_1, ..., S_t]$$

Assume that a Robot was seated on a chair, it stood up and put its right foot forward. So currently, it is standing with its right foot forward (this is its current state).

Now, according to the Markov Property, the current state of the Robot depends only on its immediate previous state (or the previous timestep) i.e., the state it was in when it stood up. And evidently, it doesn't depend on the state where it was sitting on the chair. Similarly, its next state depends only on its current state.

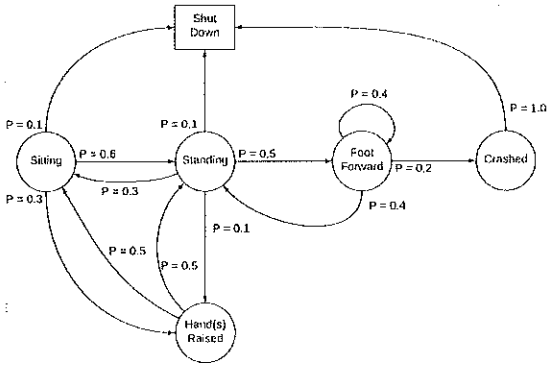
Formally, **for a *state* S_t to be Markov**, the probability of the next state **S_(t+1)** being ***s'*** should only be dependent on the current state **S_t = *s_t***, and not on the rest of the past states $S_1 = s_1$, $S_2 = s_2$...

Markov Process or Markov Chain

$$\mathcal{P}_{ss'} = \mathbb{P}[S_{t+1} = s' \mid S_t = s]$$

A Markov Process is defined by *(S, P)* where *S* are the states, and *P* is the state-transition probability. It consists of a sequence of **random** states *S 1, S 2, ...* where all the **states obey the Markov Property**.

The state transition probability or *P_ss'* is the probability of jumping to a state *s'* from the current state *s*.



To get an intuition of the concept, consider the figure above. Sitting, Standing, Crashed, etc. are the states, and their respective state transition probabilities are given.

Markov Reward Process (MRP)

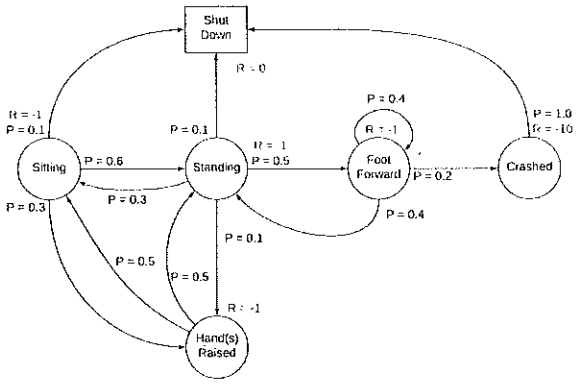
$$\mathcal{P}_{ss'} = \mathbb{P}\left[S_{t+1} = s' \mid S_t = s\right]$$

$$\mathcal{R}_s = \mathbb{E}\left[R_{t+1} \mid S_t = s\right]$$

An MRP is defined by *(S, P, R, γ)*, where *S* are the states, *P* is the state-transition probability, *R_s* is the reward, and *γ* is the discount factor (will be covered in the coming sections).

The state reward *R_s* is the **expected reward** over all the possible states that one can transition to from state *s*. This reward is received for being at the state *S_t*. **By convention**, it is said to be received after the agent leaves the state and hence, regarded as *R_(t+1)*.

For example:



Markov Decision Process (MDP)

$$\mathcal{P}^a_{ss'} = \mathbb{P}\left[S_{t+1} = s' \mid S_t = s, A_t = a\right]$$

$$\mathcal{R}^a_s = \mathbb{E}\left[R_{t+1} \mid S_t = s, A_t = a\right]$$

An MDP is defined by *(S, A, P, R, γ)*, where *A* is the set of actions. It is essentially **MRP with actions.** Introduction to actions elicits a notion of control over the Markov Process, i.e., previously, the state transition probability and the state rewards were more or less stochastic (random). However, now the rewards and the next state also depend on what action the agent picks. Basically, the agent can now control its own fate (to some extent).

Now we will discuss how to use MDPs to address RL problems.

Return (*G_t*)

The *return* G_t is the total discounted reward from time-step t.

$$G_t = R_{t+1} + \gamma R_{t+2} + \ldots = \sum_{k=0}^{\infty} \gamma^k R_{t+k+1}$$

Rewards are temporary. Even after picking an action that gives a decent reward, we might be missing on a greater total reward in the long-run. This long-term total reward is the **Return**. However, in practice, we consider discounted Returns.

Discount (*γ*)

The variable $\gamma \in [0, 1]$ in the figure is the discount factor. The intuition behind using a discount is that there is no certainty about the future rewards; i.e., as important it is to consider the future rewards to increase the

Return, it is also equally important to limit the contribution of the future rewards to the Return (Since you can't be 100% sure of the future).

And also because using a discount is mathematically convenient.

Policy (π)

A *policy* π is a distribution over actions given states,

$$\pi(a|s) = \mathbb{P}[A_t = a \mid S_t = s]$$

As mentioned earlier, a policy defines the thought behind making a decision (picking an action). It defines the behavior of an RL agent.

Formally, a policy is a **probability distribution** over the set of actions ***a***, given the current state ***s*** i.e., it gives the probability of picking an action ***a*** at state ***s***.

Value Functions

A value function is the long-term value of a state or an action i.e., the expected Return over a state or an action. **This is something that we are actually interested in optimizing.**

State Value Function (for MRP)

$$v(s) = \mathbb{E}[G_t \mid S_t = s]$$

The state value function ***v(s)*** is the expected Return starting from state ***s.***

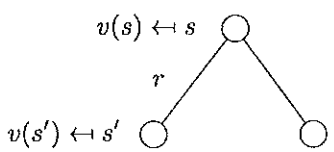
Bellman Expectation Equation (for MRP)

The Bellman Equation gives a standard representation for value functions. It essentially decomposes the value function into two components:

1. The immediate reward ***R_(t+1)***
2. Discounted value of the future state ***γ.v(S_(t+1))***

$$\begin{aligned} v(s) &= \mathbb{E}[G_t \mid S_t = s] \\ &= \mathbb{E}[R_{t+1} + \gamma R_{t+2} + \gamma^2 R_{t+3} + \dots \mid S_t = s] \\ &= \mathbb{E}[R_{t+1} + \gamma(R_{t+2} + \gamma R_{t+3} + \dots) \mid S_t = s] \\ &= \mathbb{E}[R_{t+1} + \gamma G_{t+1} \mid S_t = s] \\ &= \mathbb{E}[R_{t+1} + \gamma v(S_{t+1}) \mid S_t = s] \end{aligned}$$

For a better intuition on this, let's consider the following scenario (**for simplicity, let's consider MRPs only**):



The agent can transition from the current state ***s*** to some state ***s'***. Now, the state value function is basically the **expected value of Returns over all *s'***. Now, using the same definition, we can recursively substitute the Return of the next state ***s'*** with the value function of ***s'***. This is exactly what the Bellman Equation does:

$$v(s) = \mathbb{E}\left[R_{t+1} + \gamma v(S_{t+1}) \mid S_t = s\right]$$

Now let's solve this equation:

$$v(s) = \mathcal{R}_s + \gamma \sum_{s' \in \mathcal{S}} \mathcal{P}_{ss'} v(s')$$

So, since expectation is distributive, we can solve for both ***R_(t+1)*** and ***v(s')*** separately. We have already seen that the expected value of ***R_(t+1)*** over ***S_t=s*** is the state reward ***R_s***. And the expectation of ***v(s')*** over all ***s'*** is taken by the definition of Expected Value.

Another way of saying this would be— the **state reward is the constant value that we are anyway going to receive for being at the state *s***. And the **other term is the average state value over all *s'***.

State Value Function (for MDP)

The *state-value function* $v_\pi(s)$ of an MDP is the expected return starting from state s, and then following policy π

$$v_\pi(s) = \mathbb{E}_\pi\left[G_t \mid S_t = s\right]$$

This is similar to the value function for MRP, but there is a small difference that we'll see shortly.

Action Value Function (for MDP)

The *action-value function* $q_\pi(s, a)$ is the expected return starting from state s, taking action a, and then following policy π

$$q_\pi(s, a) = \mathbb{E}_\pi\left[G_t \mid S_t = s, A_t = a\right]$$

MDPs introduce control in MRPs by considering actions as the parameter for state transition. So, it is **necessary to evaluate actions along with states.** For this, we define action value functions that essentially give us the expected Return over actions.

State value functions and action value functions are closely related. We'll see how in the next section.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc	**B.Voc**	**Semester**	3rd
Course name / Module	Wireless Networks		
Course code	ITN1302		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

Answers

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

Q1. B
Q2. C
Q3. A
Q4. A
Q5. A

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

Q6. LMR-400 and CA-195. CA-195 is more lossy.
Q7. Free Space loss is the loss in signal strength for distance travelled by an EM wave in free space. It is given by
20log(d) + 20log(f) + 36.58 where f is in MHz and d is in miles.
Q8. Omini Direction antenna radiates in all directions whereas directional antenna radiates in one perticulat direction and has more gain.

3. Section C (03 long type questions, each question carries 03 marks)	**03×03 = 09**

Q9. Ap to Client - 8 dB and Client to Ap 10 dB.
Q10.

- Increased efficiency. Improved data communications lead to faster transfer of information within businesses and between partners and customers. ...
- Access and availability. ...

- Flexibility. ...
- Cost savings. ...
- New opportunities. ...
- Security. ...
- Installation problems. ...
- Coverage.

Q4.

- Bluetooth
- Zigbee
- Paging
- Cordless Phones
- Radio Frequency Identification (RFID)
- Cell phone networks (Cellular Communication)
- Wireless sensor networks
- Satellite communication networks
- Terrestrial microwave networks
- Television and Radio Broadcasting
- Satellite Communication
- Radar
- AM radio
- FM radio

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**Semester**	3rd	
Course name / Module	Basics of Network Security		
Course code	ITN1303		
Date			
Name of the Student		**Reg. No.**	

Section A

1.D

2.A

3.A

4.B

5.C

SECTION B

Answer 1: When talking about network security, the **CIA** triad is one of the most important models which is designed to guide policies for information security within an organization.

CIA stands for :

1. Confidentiality
2. Integrity
3. Availability

Answer 2:Network security is crucial because **it safeguards all types of data against theft and loss**. Sensitive data, protected health information (PHI), personally identifiable information (PII), intellectual property, personal information, data, and government and business information systems are all included.

- Answer 3: **White-Hat Hackers:** White-Hat Hackers are also known as Ethical Hackers. They are certified hackers who learn hacking from courses. These are good hackers who try to secure our data, websites. With the rise of cyberattacks, organizations and governments have come to understand that they need ethical hackers. They protect databases, software from Malware, Phishing, and SQL injection attacks. The government hires white hat hackers to protect their websites and databases. These hackers also work for space organizations. Some ethical hackers work with organizations that find weaknesses in their software. They take permission from the system owners and use hacking techniques identical to black hat hackers, but they do so legally. They make people aware of cyber threats and ways to prevent them.

- **Black-Hat Hackers:** Black-Hat Hackers are those hackers who enter the system without taking owners' permission. These hackers use vulnerabilities as entry points. They hack systems illegally. They use their skills to deceive and harm people. They conduct various attacks, write malware, and damage system security. They steal users' passwords, data, and credit card information by damaging system security. Black-hat hackers make money by selling data and credit card information on the dark web. They are also ruining anyone's reputation to take revenge. Sometimes they steal the personal data of users and blackmail them. They also hack social media profiles by sending links or attachments. Some countries (China, Russia, and the USA) hires black hat hacker to steal data related to militaries from other countries.

- **Gray-Hat Hackers:** Gray-Hat Hackers are a mix of both black and white hat hackers. These types of hackers find vulnerabilities in systems without the permission of owners. They don't have any

malicious intent. However, this type of hacking is still considered illegal. But they never share information with black hat hackers. They find issues and report the owner, sometimes requesting a small amount of money to fix it. But some organizations disregard gray hat hackers because the hacker is not bound by ethical hacking policies. These type of hackers does not put someone at risk.

Section C

Answer 1:

Type	What It Does	Real-World Example
Ransomware	disables victim's access to data until ransom is paid	RYUK
Fileless Malware	makes changes to files that are native to the OS	Astaroth
Spyware	collects user activity data without their knowledge	DarkHotel
Adware	serves unwanted advertisements	Fireball

Answer2 : A computer virus is a type of malicious software, or malware, that infects computers and corrupts their data and software. **Worm, ILOVEYOU, SQL Slammer, Stuxnet, CryptoLocker, Tinba, Welchia, and Shlayer** are some examples of computer viruses.

Answer 3: A Trojan Horse Virus is **a type of malware that downloads onto a computer disguised as a legitimate program**. The delivery method typically sees an attacker use social engineering to hide malicious code within legitimate software to try and gain users' system access with their software.

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc Semester	3rd	
Course name / Module	Optical Fiber Communication		
Course code	ITN1305		
Date			
Name of the Student		Reg. No.	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

Section A	05×1 = 05

Q1. Which of the following is the principle of operation of fiber- optic cable?

a) Absorption
b) Distortion
c) Dispersion
d) Reflection

Ans: (d) Reflection

Q2. Which fiber is preferred for long distance communication?

a) Step index single mode fiber
b) Step index multimode fiber
c) Graded index multimode fiber
d) Graded index fiber

Ans: (a) Step index single mode fiber

Q3. In optical fiber communications, the signal source is _____ waves.

a) Light
b) Infrared
c) Radio
d) Very low- frequency

Ans: (a) Light

Q4. In optical fiber, the inner layer is _____ and outer layer is _____ .

a) Core, Cladding
b) Reflect, Transmit
c) Transmit, Reflect
d) Cladding, Core

Ans: (a)Core, Cladding

Q5. Optical Splice provides a connection between.

a) Transmitter to fiber
b) fiber to fiber
c) Receiber to fiber
d) fiber to repeater

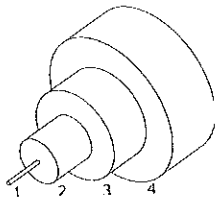
Ans: (b) fiber to fiber

Section B	03×02 = 06

Q1. What is core and cladding in optical fibers explain with diagram.

Ans: The core of a conventional optical fiber is the part of the fiber that guides the light. It is a cylinder of glass or plastic that runs along the fiber's length.The core is surrounded by a medium with a lower index of refraction, typically a cladding of a different glass, or plastic. Light travelling in the core reflects from the core-cladding boundary due to total internal reflection, as long as the angle between the light and the boundary is greater than the critical angle. As a result, the fiber transmits all rays that enter the fiber with a sufficiently small angle to the fiber's axis. The limiting angle is called the acceptance angle, and the rays that are confined by the core/cladding boundary are called guided rays.

1. Core 9 µm diameter
2. Cladding 125 µm dia.
3. Coating 250 µm dia.
4. Buffer or jacket 900 µm dia.



Q2. Write the short note on Fusion splice and Mechanical splice.

Ans: a) Fusion splicing involves heating the ends of each fiber that are being joined and fusing them together permanently. Because this process requires near-perfect alignment of the fibers and their respective cores, along with fusing the glass together in a precise manner, this is accomplished using a fusion splicer device. The device effectively aligns the two fiber ends, melts the glass via an electric arc, then fuses them together. Because of the resulting splice point in the length of fiber, either a heat-shrinkable protective splice sleeve or a coating material is typically placed over the splice point to give the splice more strength and durability.

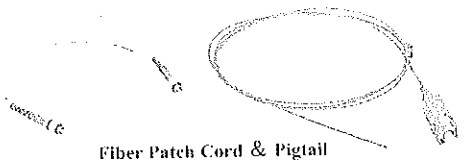
b) The primary way that mechanical splicing differs from fusion splicing is that it is a manual process that does not permanently fuse or join the fibers together, instead it locks and aligns the fiber ends together with a screw mechanism in a splice case. This method requires no heat or electricity and is performed manually by a technician using the required tools and components.

Q3. Write a short note on patch cord and pig tails.

Ans: Structures of Fiber Patch Cords and Pigtails

Fiber patch cord, also known as fiber optic patch cable or fiber jumper cable, is a short length of optical fiber cable with a connector on each end. Connector types on each side of the fiber patch cable can be different and they can also be the same.

Fiber optic pigtail is a piece of cable terminated with a fiber optic connector at only one end of the cable and leaves a length of exposed fiber at the other end, so that the connector side can link to the equipment and the other side can be melted with optical cable fibers or stripped and fusion spliced to a single fiber of a multi-fiber trunk. The following picture shows a fiber patch cord and a fiber pigtail.



Fiber Patch Cord & Pigtail

Fiber optic patch cords and pigtails structurally have much in common. They are both available in single mode and multi-mode, and they can be made into simplex and duplex. Besides, both fiber patch cord and pigtail can terminate with many kinds of fiber optic connectors, including FC, SC, ST, LC, MTRJ, MPO, MU, SMA, FDDI, E2000, DIN4, and D4.

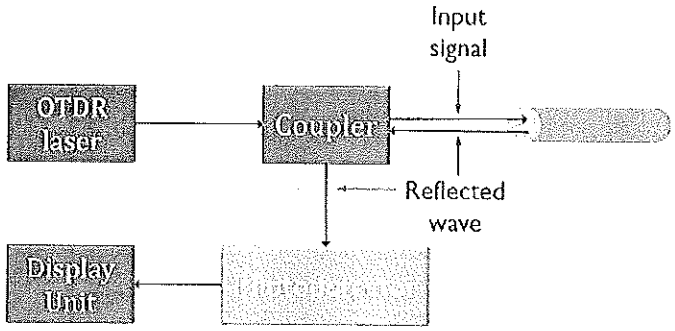
Section C	03×03 = 09

Q1. What are the advantages & disadvantage of optical fiber?

Advantages of optical fiber	Disadvantages of optical fiber
• Bandwidth is higher than copper cables • Less power loss and allows data transmission for longer distances • The optical cable is resistance for electromagnetic interference • The size of the fiber cable is 4.5 times better than copper wires and • These cables are lighter, thinner, and occupy less area compare with metal wires. • Installation is very easy due to less weight. • The optical fiber cable is very hard to tap because they don't produce electromagnetic energy.	• The optical fiber cables are very difficult to merge & there will be a loss of the beam within the cable while scattering. • The Installation of these cables is cost-effective. They are not as robust as the wires. Special test equipment is often required to the optical fiber. • Fiber optic cables are compact and highly vulnerable while fitting • These cables are more delicate than copper wires. • Special devices are needed to check the transmission of fiber cable.

Q2. What is the principle of OTDR? Explain.

Ans: An OTDR sends short pulses of light into a fiber. Light scattering occurs in the fiber due to discontinuities such as connectors, splices, bends, and faults. The OTDR then detects and analyzes the backscattered signals.



Operation of OTDR

Q3. What are the types of fiber optic connectors?

ANS:ST Connector: The ST connector remains one of the most widely used connectors especially for multimode networks such as college campuses and most buildings.

SC Connector: The SC is a snap-in connector which also features a 2.5mm ferrule much like the ST connector and is known for its excellent performance.

Ferrule Core (FC) Connector: The FC connector was widely popular within fiber optic networks however its use has been dwindling in recent times replaced with SC and LC.

MT-RJ: The MT- RJ is a duplex connector where both fibers are in a single polymer ferrule. It utilizes pins for alignment and has male, female, and plug and jack formats.

Lucent Connector (LC): The LC connectors are highly popular within single mode networks. It is known for good performance and small size. LC connectors have a 1.25mm ferrule, approximately half the size of SC connectors. It's also commonly referred to as the "little connector".

Plastic Fiber Optic Cable Connectors: Plastic FOC connectors are not very popular when compared to glass fiber. These connectors are cheap and are mainly designed and used for easy application. Polished or epoxy options are usually not available with plastic connectors.

Opti-Jack: Opti-Jack duplex connectors greatly resemble the commonly known RJ-45 connector. The rugged duplex connector is designed around two ST-Type ferrules and maintains the same size as RJ-45 connectors. The connectors are plug and jack (male and female).

LX-5: The LX-5 is much like an LC connector but features a shutter over the end of the fiber. The LX-5 is known to provide high density, high performance, and reliable connections

MU: MU connectors resemble a miniature version of SC with a 1.25mm ferrule. Its small size allows the MU connector to have a reduced footprint and are used in dense applications

E2000 Connector: The E2000 connector is mainly used in modern telecommunication networks. The connector features a unique spring-loaded shutter that protects the ferrule from dirt, dust, and scratches. Since the connector uses a monobloc ceramic ferrule, problems related to different co-efficient of expansion are nonexistent. The E2000 utilizes a push-pull locking connector.

MPO/MTP connectors: MPO or MTP terminated cables are widely used in high-density cabling environments like data centers. Traditional, tight-buffered multi-fiber cable needs to have each fiber individually terminated by a skilled technician.

PRACTICAL1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	B.Voc	Semester	
Course name / Module	OE-(3D Printing)		
Course code	ITN1110		
Date			
Name of the Student		Reg. No.	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

Section A	05×1 = 05

Q1. Which one of the following is the correct dimension of SLA 3D Printer build volume size?

a) 128mm X138mm X 143mm
b) 128mm X128mm X 300mm
c) 128mm X128mm X 200mm
d) None of the above

Ans: c) 128mm X128mm X 200mm

2. Which one of the following is the correct dimension of MAX500 FDM 3D Printer build volume size?

a) 400mm X 300mm X 500mm
b) 500mmX500mm X 300mm
c) 500mm X 500mm X 500mm
d) 300mmX400mm X 300mm

Ans: c) 500mm X 500mm X 500mm

3. Which one of the following is the correct dimension of Da Vinci 3D Printer build volume size?

a) 290mm X 290mm X 300mm
b) 350mm X300mm X 300mm
c) 350mm X 350mm X 350mm
d) None of the above

Ans: a) 290mm X 290mm X 300mm

4. Which one of the following is the correct dimension of MAX300 FDM 3D printer build volume size?

a) 300mm X200m X 140mm
b) 300mmX300mm X 300mm
c) 300mm X300mm X 500mm
d) 350mm X300mm X 300mm

Ans: b) 300mmX300mm X 300mm

5. Which one of the following is the correct dimension of AHA FDM 3D Printer build volume size?

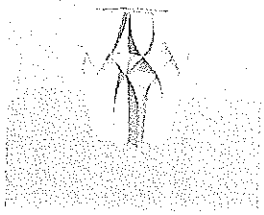
a) 230mm X 230mm X 230mm
b) 128mm X230mm X 230mm
c) 128mm X 230mm X 200mm
d) 300mmX200mm X 300mm

Ans: a) 230mm X 230mm X 230mm

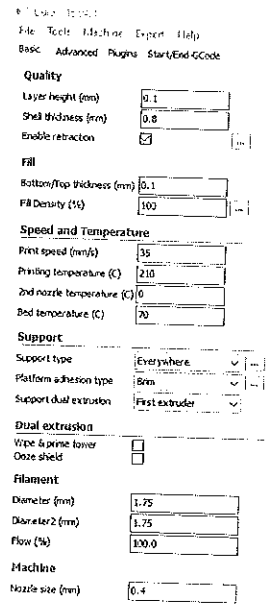
Section B	03×02 = 06

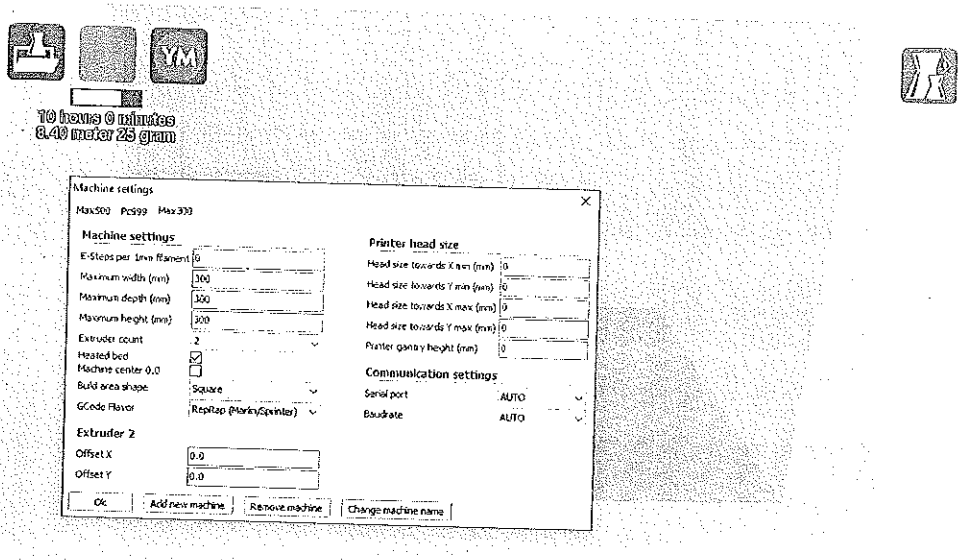
Q1. Print the single colour file given below on FDM MAX300 3D Printer, as instructed by the examiner.

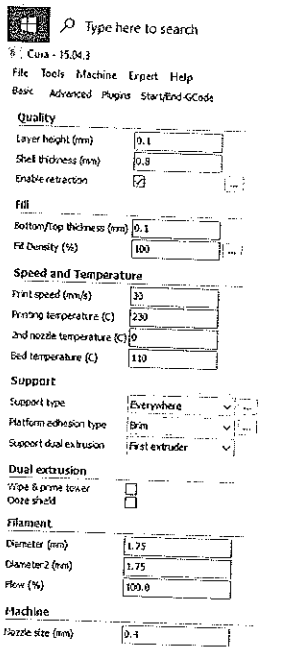
a) **Add machine in slicing software**
b) **Add all parameters in slicing software**
c) **Use material ABS**
d) **Save Code**

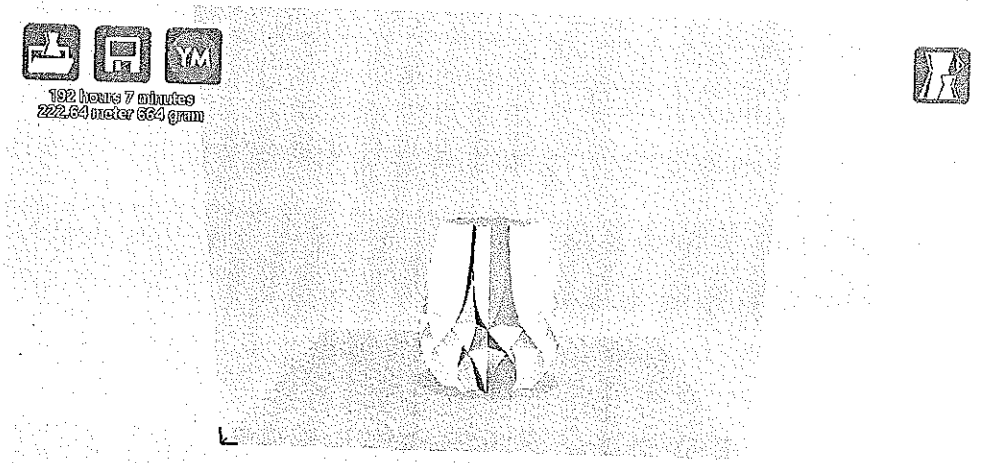


Ans: Slicing software used in cura





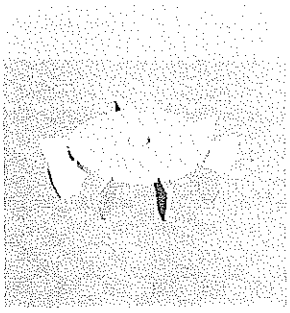




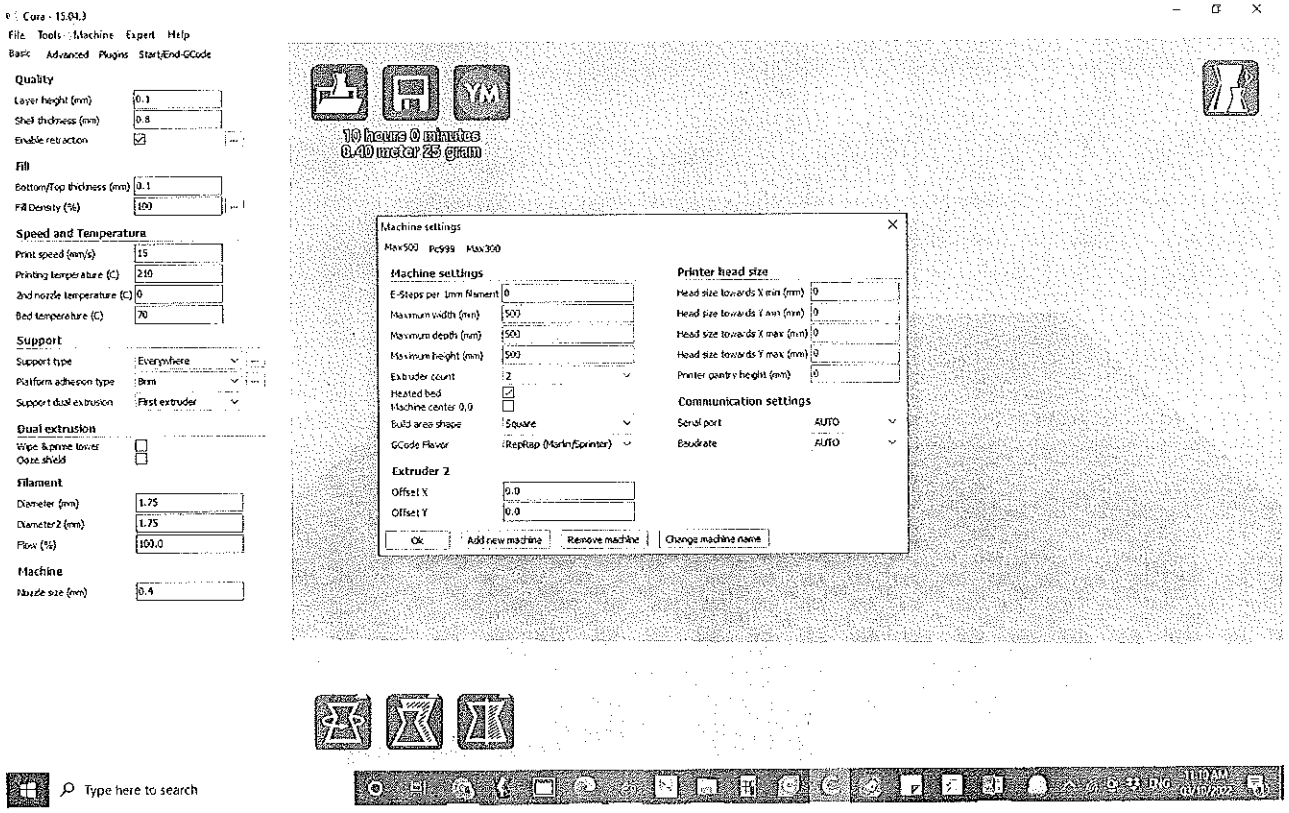
Section C	03×03 = 09

Q2. Print the single colour file given below on FDM MAX500 Printer, as instructed by the examiner.

a) **Add machine in slicing software**
b) **Add all parameters in slicing software**
c) **Use material PLA**
d) **Save Code**



Ans: The software name is cura



Cura - 15.04.3

File Tools Machine Expert Help

Basic Advanced Plugins Start/End-GCode

Quality

Layer height (mm)	0.1
Shell thickness (mm)	0.8
Enable retraction	☑

Fill

Bottom/Top thickness (mm)	0.1
Fill Density (%)	100

Speed and Temperature

Print speed (mm/s)	35
Printing temperature (C)	210
2nd nozzle temperature (C)	0
Bed temperature (C)	70

Support

Support type	Everywhere
Platform adhesion type	Brim
Support dual extrusion	First extruder

Dual extrusion

Wipe & prime tower	☐
Ooze shield	☐

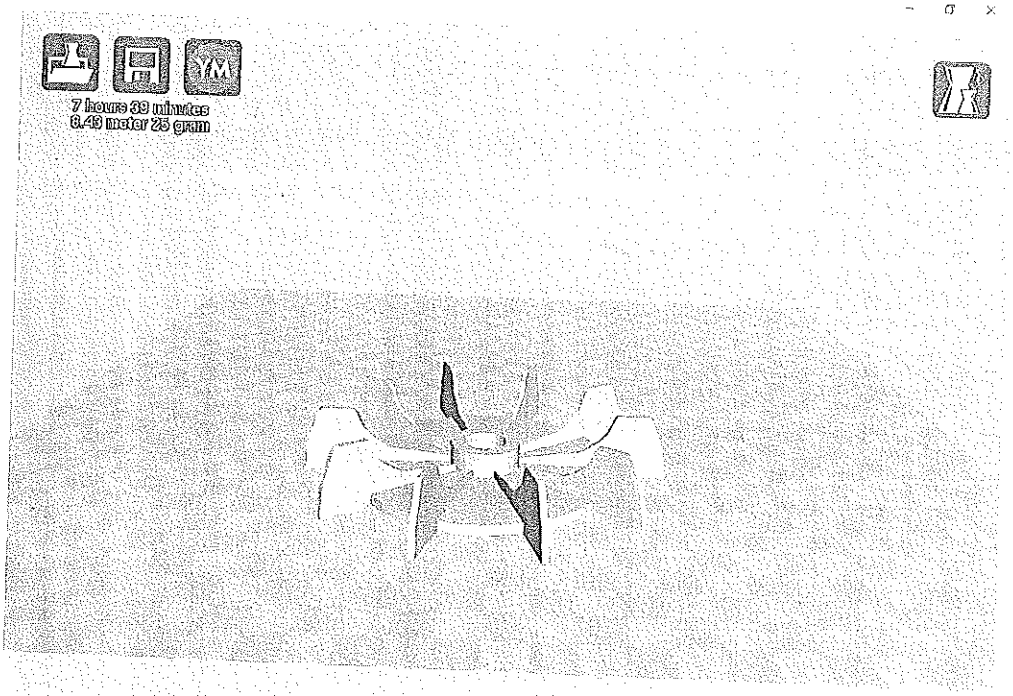
Filament

Diameter (mm)	1.75
Diameter2 (mm)	1.75
Flow (%)	100.0

Machine

Nozzle size (mm)	0.4

7 hours 39 minutes
6.49 meter 25 gram



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THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**Semester**	3rd/5th	
Course name / Module	PCB Designing and Manufacturing		
Course code	ITN1111		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS

- Maximum Marks: **20**
- Duration of Examination: **01 Hour**
- Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark) **05×1 = 05**

1) For carbon resistors what is the color for 5?
(A) Green (B) Black
(C) Orange (D) Gray.
(A) Green

2) The four stripes of a resistor are yellow-violet-orange-gold. The value of resistor should be
(A) 470 ohms ± 5 % (B) 47 kilo ohm ± 5%
(C) 47 mega ohms ± 5% (D) 4700 ohms ± 10%
(B) 47 kilo ohm ± 5%

3) The tolerance for silver stripe is
(A) +5% (B) + 10%
(C) ± 5% (D) ± 10%.
(D) ± 10%.

4) Which of the following carbon coded resistor has value of 10 K-ohm with 20% tolerance?
(A) Red, red, green and silver stripes
(B) Yellow, violet, yellow and silver stripes
(C) Orange, orange, black and gold stripes
(D) Brown, black, orange and no tolerance band.
(D) Brown, black, orange and no tolerance band.

5) What is the unit of capacitance?
A) henry B) farad
C) ohm D) none
B) farad

2. Section B (03 short answer type questions, each question carries 02 marks) **03×02 = 06**

1. What is the difference between active and passive components?
Active components

- ✓ Active components deliver power to the circuit.
- ✓ Examples: Diodes, transistors, SCR, integrated circuits etc.
- ✓ Devices which produce energy in the form of voltage or current.
- ✓ They require an external source for the operations.

Passive components:

- ✓ Passive elements utilize power in the circuit.
- ✓ Examples: Resistor, capacitor, inductor etc.
- ✓ Devices which stores energy in the form of voltage or current.
- ✓ They do not require any external source for the operations.

2. What are the classification of capacitors? Write just names.

Capacitors can store an electrical charge on their plates when connected to a voltage source.

Capacitors types

- Variable Capacitors
- Fixed Capacitors
  - Paper Capacitors
  - Mica Capacitors
  - Ceramic Capacitors
  - Plastic Capacitors
  - Electrolytic Capacitors

3. What is the difference between transistor and MOSFET?

Transistor

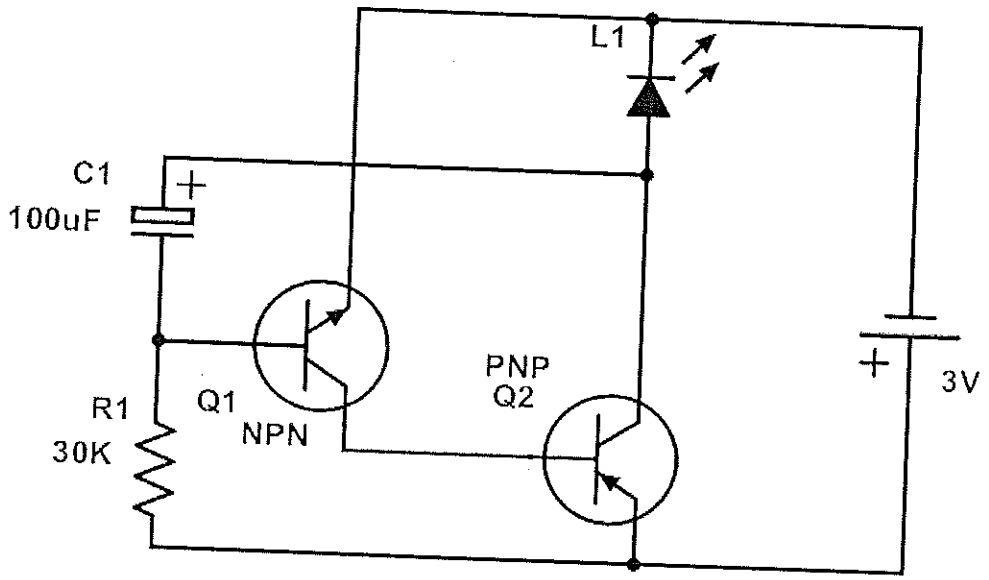
- Current controlled switch
- A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power.
- NPN type
- PNP type

MOSFET

- Metal-oxide-semiconductor field-effect transistor
- Voltage controlled switch, that can turn things on and off.
- N-channel
- P-channel

3. Section C	**09**

1. Design single sided PCB layout of the given circuit.



Note: Marks distribution

1	Schematic design	1 Mark
2	Component value assignment	1 Mark

3	Electric rules check and correction	1 Mark
4	Netlist generation	1 Mark
5	Footprint assignment	2 Marks
6	PCB layout design	2 Marks
7	Gerber file generation	1 Mark
	Total	**9 Marks**

THEORY 1st - IN-SEM EXAMINATION			
SESSION: 2022-23(SUMMER SEMESTER)			
B.Voc/M.Voc	**Semester**	5th	
Course name / Module	Internet of Things (IoT)		
Course code	ITN1504		
Date			
Name of the Student		**Reg. No.**	

INSTRUCTIONS
• Maximum Marks: **20**
• Duration of Examination: **01 Hour**
• Attempt all questions.

1. Section A (05 objective type questions, each question carries 01 mark)	**05×1 = 05**

1. Which of the following category is used for business to consumer process?
   A) Industrial IoT B) Group IoT
   C) Community IoT D) Personal IoT

A) Industrial IoT

2. Which is the future application of IoT?
   A) QoS in communication B) Secure communication
   C) Multimedia communication D) Role of green IoT system

D) Role of green IoT system

3. In IoT, most common application for voice control application are _____
   A) Home security and health monitoring B) Home security
   C) Family health monitoring D) Business

A) Home security and health monitoring

4. Which of the following issues are considered in IoT?
   A) Security Issue B) Reliability Issue
   C) Standard Issue D) All issues

D) All issues

5. Voice recognition software and virtual assistant programs offer for _____ and _____
   A) Communication B) Entertainment
   C) Communication and Software D) Communication and Entertainment

D) Communication and Entertainment

2. Section B (03 short answer type questions, each question carries 02 marks)	**03×02 = 06**

1. What is the need for IoT?

Ans.: Need for IoT

This technology reduces human efforts and saves a lot of time. For devices to interact, collaborate and share experiences, we need IoT. To reducing human intervention into a machine cycle. IoT wants to connect all potential objects to interact each other on the internet to provide secure, comfort life for human. There are many more reasons for need for IoT.

- Environmental Monitoring

- Infrastructure Management
- Industrial Applications
- Energy Management
- 5.Medical and Healthcare Systems
- Building and Home Automation
- Transport Systems
- Large Scale Deployments

2. What are the different categories of IoT?

Ans.: IoT categories

There are three categories of IoT:

1. Consumer IoT

2. Commercial IoT

3. Industrial IoT (IIoT)

Consumer IoT: Basically, Consumer IoT solutions are focused on individual users or families through the use of wearables, smart home applications, and personal monitoring devices. A suitable example are smart voice assistants such as Amazon's Echo, Google's Home, and Apple's Home Pod; in other words, products that make our lives easier by performing tasks or services for us.

Commercial IoT: Commercial IoT targets our daily environment outside of the home (consumer IoT). There is a set of applications that can be deployed in places we frequently visit such as commercial office buildings, supermarkets, stores, hotels, healthcare facilities, or entertainment venues. The applications for these places vary from variables monitoring to environmental conditions, personal control schedule, building access, as well as connected lighting, asset tracking, and many more.

Industrial IoT: Unlike Consumer IoT, Industrial IoT targets existing automated industrial systems looking for dramatic improvements in productivity and efficiency. The most common sectors that come to mind could be large scale factories or manufacturing plants, but these are also known for monitoring utilities and expensive assets. Basically, we can say that we're entering a whole new era of IoT. The existing automated industrial systems inside factories tend to be older because the systems may have been installed more than a decade ago, therefore, integrating the information from these systems to support IoT could get more complicated than commercial IoT, due to the tasks that integrators have to do carry out, manage, and adapt to the existing infrastructure.

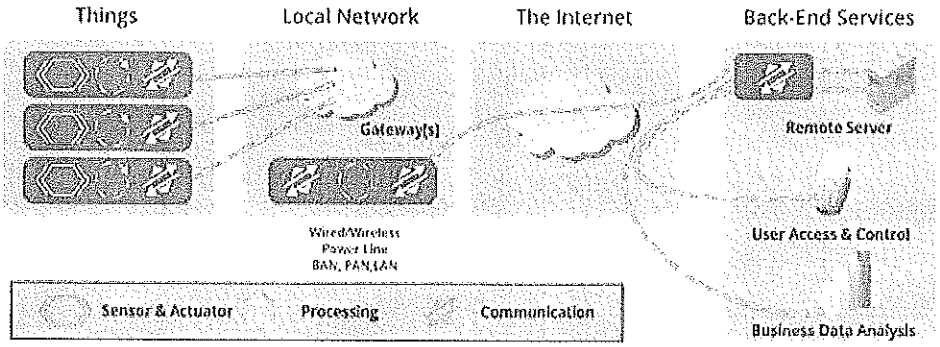
3. What is IoT and how it works?

Ans.: The Internet of Things (IoT) describes the network of physical objects "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

How does IoT work?

Internet of Things is a combination of smart electronic devices, local area networks, the Internet, cloud servers, and the user application.

An IoT system consists of four major components as shown in the below image:



An IoT device connects through a local network. Then, it transmits information through the Internet to the cloud servers. Further, the cloud servers provide the data or information of the end-user application to the IoT device. This transfer of information is a two-way communication that helps operate the IoT system.

3. **Section C** (03 long type questions, each question carries 03 marks)	**03×03 = 09**

1. Why IoT is important for the business world today?

Ans.: Business Overview of Why IoT is so important

1.Increased efficiency and productivity: A business can significantly increase its productivity by knowing the needs of its customers. This can be achieved by instrumenting smart devices into operations to improve efficiency, so that more can be done in less time. Additionally, large-scale tasks can be completed faster and faultlessly with the help of IoT-based software and appliances.

2. Inventory tracking and management: IoT has the potential to transform the way companies track and manage their inventory. Businesses that depend on manufacturing, warehousing and storage will be able to monitor changes in their inventory automatically, with the help of smart devices. This will save plenty of time for workers to perform more important, insightful and challenging tasks.

3. Data sharing: Smart devices are known to keep a track of consumer behavior, which is essential for a business to function and flourish. This gathering and exchanging information process has completely changed the way data is handled. IoT devices do not just offer access to consumer data, but also track and record their usage patterns of how a consumer interacts with these devices via machine learning.

4. Remote working: IoT is believed to open the door for remote work. The ability to connect multiple devices to the same network will allow employees working remotely to be closer and more connected to their job than ever before. Such workers will be able to complete their tasks from remote locations by connecting to devices in the office or factory floor.

5. Shorter buying decision cycles: IoT is also going to change the way consumers purchase products, as the buying cycle is said to become shorter. The targeted advertising enabled by the technology will further facilitate buying decision-making process, which will allow customers to anticipate a faster and convenient delivery service. For instance, placing an order through Amazon Echo to receive products the same day – this urge for instant gratification will bring forth new demands on businesses, which will require them to make the most of smart technology in order to keep a track of consumer demands.

6. Creating new consumer demands: In order to expand their reach, businesses will have to keep in mind that as consumers will be acquainted with IoT, they will start demanding things that they did not know they wanted before, expecting extra every time they make a new purchase. There will be a time when smart devices will become the new standard for appliances and other day-to-day usable things.

7. IoT expertise: As organizations will employ IoT into their businesses, they will also need to hire IoT experts. Just implementing the technology would not suffice. The more businesses start hiring IoT specialists, the more individuals will be willing to learn about advanced technology. Furthermore, recruiting data analysts would prove to be add-on assistance to the experts' team.

2. What is Wireless Sensor Network? Just brief its challenges and applications.

Ans. WSN is a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind, and so on.

Challenges in WSN

Energy efficiency

- Offering guarantees in terms of bandwidth, delay, jitter, packet loss probability.
- Limited bandwidth, unpredictable changes in RF channel characteristics.

Security

- Open medium.
- Nodes prone to malicious attacks, infiltration, eavesdropping, interference.

Scalability

- Providing acceptable levels of services in the presence of large number of nodes.
- Typically, throughput decreases at a rate of $1/\sqrt{N}$, N=number of nodes.

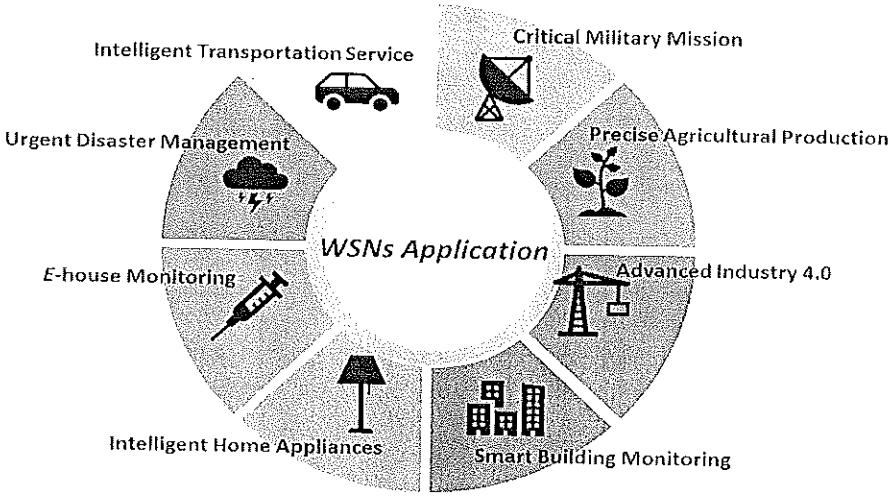
Quality of services

- Offering guarantees in terms of bandwidth, delay, jitter, packet loss probability.
- Limited bandwidth, unpredictable changes in RF channel characteristics.

Limited bandwidth

Node cost
Deployment
Decision constraints

WSN Applications: there are so many applications of wireless sensor network.



3. What kind of sensors are used in IoT? Explain.

Ans.: IoT Sensor

Sensors are devices that respond to inputs from the physical world and then take those inputs and display them, transmit them for additional processing, or use them in conjunction with artificial intelligence to make decisions or adjust operating conditions. As the IoT initiative expands, more and more sensors are going to be used to monitor and collect data for analysis and processing. Sensors are designed to respond to specific types of conditions in the physical world, and then generate a signal (usually electrical) that can represent the magnitude of the condition being monitored. Those conditions may be light, heat, sound, distance, pressure, or some other more specific situation, such as the presence or absence of a gas or liquid. The common IoT sensors that will be employed include:

Temperature sensors: Temperature sensors detect the temperature of the air or a physical object and concert that temperature level into an electrical signal that can be calibrated accurately reflect the measured temperature.

Pressure sensors: Pressure sensors measure the pressure or force per unit area applied to the sensor and can detect things such as atmospheric pressure, the pressure of a stored gas or liquid in a sealed system such as tank or pressure vessel, or the weight of an object.

Motion sensors: Motion sensors or detectors can sense the movement of a physical object by using any one of several technologies, including passive infrared (PIR), microwave detection, or ultrasonic, which uses sound to detect objects.

Level sensors: Level sensors translate the level of a liquid relative to a benchmark normal value into a signal. Fuel gauges display the level of fuel in a vehicle's tank, as an example, which provides a continuous level reading.

Image sensors: Image sensors function to capture images to be digitally stored for processing.

Proximity sensors: Proximity sensors can detect the presence or absence of objects that approach the sensor through a variety of different technology designs.

Water quality sensors: The importance of water to human beings on earth not only for drinking but as a key ingredient needed in many production processes dictates the need to be able to sense and measure parameters around water quality.

Chemical sensors: Chemical sensors are designed to detect the presence of specific chemical substances which may have inadvertently leaked from their containers into spaces that are occupied by personnel and are useful in controlling industrial process conditions.

Gas sensors: Related to chemical sensors, gas sensors are tuned to detect the presence of combustible, toxic, or flammable gas in the vicinity of the sensor.

Smoke sensors: Smoke sensors or detectors pick up the presence of smoke conditions which could be an indication of a fire typically using optical sensors (photoelectric detection) or ionization detection.

Infrared (IR) sensors: Infrared sensor technologies detect infrared radiation that is emitted by objects.
Acceleration sensors: While motion sensors detect movement of an object, acceleration sensors, or accelerometers as they are also known, detect the rate of change of velocity of an object.
Gyroscopic sensors: Gyroscopes or gyroscopic sensors are used to measure the rotation of an object and determine the rate of its movement called the angular velocity, using a 3-axis system.
Humidity sensors: Humidity sensors can detect the relative humidity of the air or other gas, which is a measure of the amount of water vapor contained in that gas.
Optical sensors: Optical sensors respond to light that is reflected off of an object and generate a corresponding electrical signal for use in detecting or measuring a condition.