

2023-24

**B.TECH. (AUTUMN SEMESTER) EXAMINATION  
ARTIFICIAL INTELLIGENCE  
ARTIFICIAL NEURAL NETWORKS**

AIC-3060

Maximum Marks: 60

Credits: 04

Duration: Two Hours

**Note:**

- (i) Attempt all questions. Assume any suitable data, if needed.
- (ii) Symbols have their usual meanings.
- (iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No.	Question	CO	M.M.
1(a)	Define the McCulloch-Pitts neuron and the perceptron. Highlight the key similarities and differences in their basic structures and functionalities.	CO1	5
1(b)	Draw the architecture of the "15-10-4-2" feed-forward neural network. How knowledge and prior information is built into this neural network? Explain.	CO1	5
1(c)	Explain the concepts of momentum and learning rate decay in the context of optimization algorithms like gradient descent with Momentum. How do these concepts enhance the performance of gradient descent?	CO2	5
2(a)	Consider a neural network as shown in Fig 1, with three input neuron, one hidden layer and two output neuron that uses a sigmoid function.	CO2	8

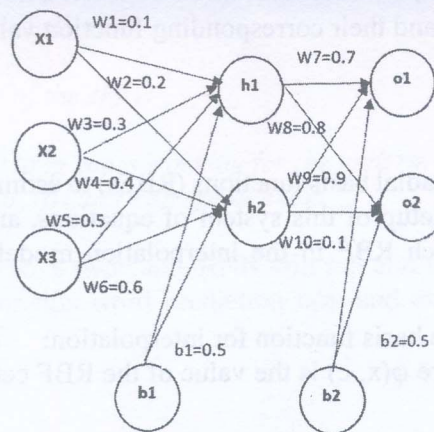


Fig. 1.

Perform a forward pass to calculate the first predicted value and backpropagation to calculate  $\nabla w_7$ ,  $\nabla w_1$  and  $\nabla b_1$ . Take the loss function as the sum of square residual (SSR). Data are as follows:

$x_1 = 1, x_2 = 4, x_3 = 5, \text{true\_value1} = 0.1, \text{true\_value2} = 0.05.$

contd....2.

- 2(b) You are working on a binary classification problem where you aim to distinguish between images of cats and dogs. The dataset consists of 100 instances. The model trained on this dataset achieves a training accuracy of 99%, but a test accuracy of only 30%. CO2 7
- i. Explain whether this scenario indicates overfitting, underfitting, or neither in the context of the given problem. Justify your answer.
  - ii. After some time, you realize that the dataset is very small, so discuss at least three data augmentation techniques that you can employ to address the challenge of limited data.
  - iii. Which activation function do you prefer for this image classification task? Justify your answer.

OR

- 2(b') Consider the Fig. 2 Convolutional Neural Network. Evaluate the total number of parameters at each convolution, pooling, and fully connected layer. CO2 7

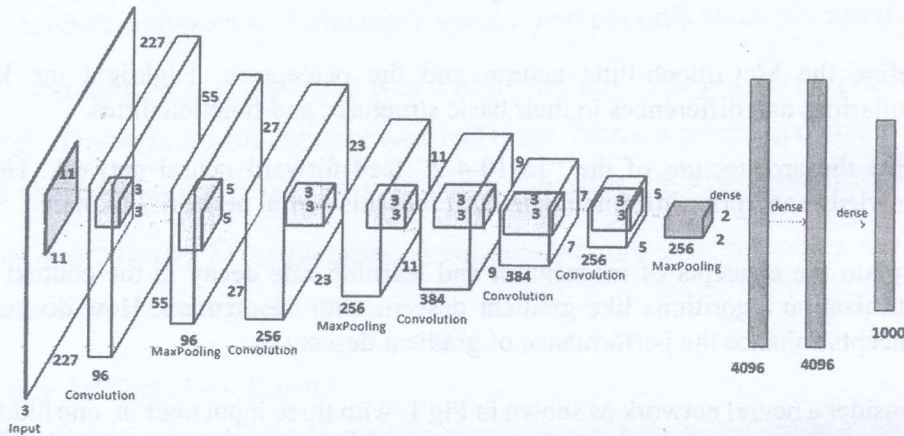


Fig. 2

- 3(a) Consider a dataset of points and their corresponding function values. CO3 8
- $(x_1, f(x_1)) = (1.0, 2.0)$   
 $(x_2, f(x_2)) = (2.0, 3.0)$   
 $(x_3, f(x_3)) = (3.0, 4.0)$

Perform interpolation using radial basis functions (RBFs) to estimate the function value at  $x = 2.5$ , show the setup of this system of equations, and calculate the weights ( $w_1, w_2, w_3$ ) for each RBF in the interpolation model using a linear system of equations.

Use the Gaussian RBF as the basis function for interpolation:

$\phi(x, c) = \exp(-\|x - c\|^2)$ , where  $\phi(x, c)$  is the value of the RBF centered at  $c$  with a data point  $x$ .

- 3(b) In terms of the dimensionality of hypersurface, perform a nonlinear mapping from input space to the hidden space. Show the separating capacity of surface in terms of expectation of hypersurface. CO4 7

OR

contd... 3.

3'(a) Solve XOR problem using Radial Basis Function (RBF). Show the output of the hidden layer corresponding to each input pattern and decision boundary in the  $\phi$ -space of hidden layer outputs. CO3 8

3'(b) Give the solution of Euler-Lagrange equation for Tikhonov functional using Green's function  $G(x, \xi)$ , where  $x$  is a parameter and  $\xi$  is an argument. CO4 7

4(a) Consider a self-organizing map (SOM) network that consists of 4 training samples, each input vector of length 4 and 2 outputs. CO3 8

Training Samples:

x1: (1,0,1,0)

x3: (1,1,1,1)

x2: (1,0,0,0)

x4: (0,1,1,0)

Initial weight matrix:

$$\begin{pmatrix} \text{Unit 1} & = & 0.3 & 0.5 & 0.7 & 0.2 \\ \text{Unit 2} & = & 0.6 & 0.7 & 0.4 & 0.2 \end{pmatrix}$$

- i. Train the SOM network by determining the class memberships of the input data for single iteration only.
- ii. After the winner for every input  $x$  has been identified, adjust the weights accordingly with the learning rate,  $\alpha = 0.6$ .

4(b) Differentiate between feed-forward neural networks and self-organizing maps (SOMs). Explain the different types of SOMs along with their architectures. Also, explain the essential processes in the formation of SOMs. CO4 7

OR

4(b') Explain the working of Recurrent Neural Network (RNN). You are working on a word prediction problem using RNN. The problem has two cases for word prediction: CO4 7

1. *The color of the sky is \_\_\_\_\_.*

2. *I spent 20 long years working for the underprivileged kids in Spain. Then I moved to Africa. I can speak fluent \_\_\_\_\_.*

In which of the above two cases RNN will fail and why? Give reasons. Suggest another model for this word prediction task and explain how it can solve the problem in RNN.

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(6538)

2023-24  
B.TECH. (AUTUMN SEMESTER) EXAMINATION  
ARTIFICIAL INTELLIGENCE  
AI SYSTEM DESIGN  
AIC-3070

Maximum Marks: 60

Credits: 04

Duration: Two Hours

**Note:**

- (i) Attempt all questions. Assume any suitable data, if needed.
- (ii) Symbols have their usual meanings.
- (iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No.	Question	CO	M.M.
1(a)	"Machine Learning in research is different from Machine Learning in production". What do you understand by this statement? Using examples, explain different parameters in which these two differ.	CO1	7
1(b)	Suppose you have been tasked to develop a model for building a ranking system for newsfeed on a social network. The business objectives are defined as: a. Minimize the spread of misinformation b. Maximize revenue from sponsored content c. Maximize engagement  How would you approach this problem while satisfying the objectives and including the scope for future tweaking of model? Justify your choices.	CO1	8
2(a)	Suppose you want to build a model for classifying rumor on X (twitter). From previous knowledge you already know that: a. There are about 15M tweets from 15000 users over a span of a year. b. No of tweets per user follows a long-tail distribution. c. Only about 1% of the tweets are rumors.  What will be your sampling strategy to sample 100000 tweets from historical data for labeling? Justify your choice.  What will be your strategy to sample 10000 tweets from streaming data such that each tweet has an equal chance of being sampled?	CO2, CO3	7

Contd...20

2(b) Imagine that you have to build two different machine learning models (Model 1 and Model 2) for: CO2, CO3 8

Model 1: Detecting lung cancer in patients through CT images.  
Model 2: Classifying Spam in emails through text.

You have collected the data, but it is yet to be labeled. What will be your labeling strategy for each case, given that you have only one month to prepare the data.

OR

2(b)' Suppose your model has an accuracy of 60% on 10K labels. You crowdsource data to get 1 million labels in total but the accuracy of your model decreases to 45%. What could be the possible reasons for the decrease in the performance of your model? Suggest ways to alleviate the problems caused due to this scenario. Justify your answers. CO2, CO3 8

3(a) Suppose you have two models for detecting cancer in patients. The confusion matrices of two models are given as: CO3, CO4 8

Model A	Actual CANCER	Actual NORMAL
Predicted CANCER	10	10
Predicted NORMAL	90	890

Model B	Actual CANCER	Actual NORMAL
Predicted CANCER	90	90
Predicted NORMAL	10	810

Examine and interpret performance of both the models. Particularly justify:

- a. Which is the better performing model among the two?
- b. Which performance metrics should we use in the above cases and why?

3(b) Suppose you are tasked to build a recommendation system (like Amazon shopping recommendation) that recommends brands from different vendors to the customers, in real-time. Among other implicit requirements, your model specifically needs to: CO3, CO4 7

- 1. Be able to handle existing brands.
- 2. Be able to handle new brands as they are added.
- 3. Be able to recommend every brand.

contd...3.

4. Be able to handle famous brands joining as new vendor/brand.

Explain the feature encoding process and justify your choices.

OR

- |       |   |          |   |
|-------|---|----------|---|
| 3(b)' | What do you understand by ensembles in Machine Learning? Explain different types of ensemble models and critically analyse their viability in Machine Learning production.  | CO3, CO4 | 7 |
| 4(a)' | Compare Batch and Online prediction on the basis of different parameters. Explain with an example, different challenges in the online prediction systems. Also, list some real-world examples of each system.   | CO3, CO4 | 7 |
| 4(b)  | Suppose you have to train a large machine learning model and you do not have resources to fit your model or data into memory. Explain the ways in which you can still train your machine learning model on a cluster of GPUs. Also examine different issues of training such a model. | CO3, CO4 | 8 |
| OR    |   |          |   |
| 4(b)' | Why do we need model compression in Machine Learning production systems? What are the different ways to provide model compression? Explain each with an example.  | CO3, CO4 | 8 |
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2023-2024  
**B. TECH. (AUTUMN SEMESTER) EXAMINATION**  
**(COMPUTER ENGINEERING)**  
**MICROPROCESSOR THEORY AND APPLICATIONS**  
**(COC-3090/AIC3090)**

Duration: Two Hours

MM: 60

NOTE: (i) Attempt all questions. All questions carry equal marks  
(ii) You may choose alternative, if indicated by 'OR'  
(iii) Marks allotted to each question and course outcome (CO) covered are indicated against each question.

Q. No	Questions	CO's	Marks
1 (a)	Name the control and status signals of 8085 microprocessor. Explain the use of each signal pin.	CO1	7
(b)	Draw the block diagram of 8085 microprocessor and explain the functions of the following registers: (i) W & Z registers (ii) Temporary register (iii) Instruction register	CO1	8
OR			
(b')	Draw the timing diagram for the instruction PUSH B. Assume that the opcode C5 is stored at a memory location 2056H, B = 32, C = 57 and SP = 2099H.	CO1	8
2 (a)	After the execution of instruction RIM, the accumulator contained 49H. Explain the accumulator contents.	CO4	7
(b)	Compare the similarities and differences of CALL and RET instructions with PUSH and POP instructions.	CO3	8
OR			
(b')	Write an assembly language program based on 8085 microprocessor instruction set to search the smallest data in a set of twenty 8-bit numbers stored in memory.	CO3	8
3 (a)	For the following data declaration, show the memory picture in x86 processor. Assume that beginning of array <i>list</i> , i.e <i>list</i> [0] is stored at 0x6000f0	CO2	5

*list*    dd    101, 103, 105, 107

Contd.....2

(b) Assume the following data declaration: CO3 5

section .data

```
list dd 1002, 1004, 1006, 1008, 10010
len dd 5
sum dd 0
```

Write assembly language program segment for x86 processor to find sum of the numbers declared in list using loop instruction.

(c) What is the general format of memory addressing in x86-64 processor? Write the x86-64 instruction to explain the following addressing modes: CO2 5

Register, Immediate, Memory

4 (a) What do you understand by command word of 8259 programmable interrupt controller? Explain initialization for different ICWs and OCWs. CO4 7

(b) Explain the operation of 8255 PPI Port A programmed as input and output in Mode 1 with necessary handshaking signals. CO5 8

OR

(b') Draw the control word of 8253 timer/counter and list the operating modes of 8253 timer/counter. CO5 8

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2023-24  
**B.TECH. IV SEMESTER EXAMINATION**  
**COMPUTER ENGINEERING**  
**OPERATING SYSTEMS**  
**COC-3100/AIC3100**

Maximum Marks: 60

Credits: 04

Duration: Two Hours

*Answer all the questions.*

*Make reasonable assumptions for missing data.*

*Notations and abbreviations have their conventional meaning.*

Q.No.	Question	CO	M.M.
1(a)	State true or false: (i) Multiprogramming means running many processes in parallel. (ii) Graphical user interface (GUI) is always provided by an OS. (iii) A reason for a parent process to terminate its child is that the parent has spawned another child process. (iv) A process goes from running to waiting state when there is an interrupt. (v) Throughput is the average number of processes in the ready queue. (vi) Waiting time + execution time + I/O time is called response time. (vii) Waiting time is the time a process waits as a parent for the child to complete. (viii) Virtual memory is another term for the hard disk.	CO1	[8]
1(b)	With the help of a diagram explain the UNIX system structure, and discuss the importance of layered approach in system design.	CO5	[7]
<b>OR</b>			
1(b')	Differentiate between system calls and API. Explain the various categories of system calls taking examples from Windows and Linux.	CO5	[7]
2(a)	For processes (P1, P2, P3, P4, P5) arrival times are (0, 1, 2, 3, 4), burst sizes are (10, 1, 2, 1, 5) both in <i>ms</i> , and priorities are (3, 1, 4, 5, 2), with the convention that smaller the number, higher is the priority. Draw Gantt charts and calculate average waiting time for each of (i) preemptive priority, (ii) preemptive SJF, and (iii) FCFS scheduling algorithms.	CO2	[8]
2(b)	With the help of suitable diagrams explain multithreading and its various models. Explain the concepts of SMP and processor affinity.	CO2	[7]

**OR**

*contd...2.*

2(b') What is a process? Draw a diagram to explain the structure of a process in memory, thereby explaining heap and stack. Draw a state diagram showing the process states and their transitions. CO2 [7]

3(a) Using the 2-process Peterson's algorithm, design a solution for critical section problem, first for 3 processes, then for n process. Also, argue that your solution is correct. CO3 [8]

3(b) What are semaphores? Describe the structures of producer and consumer processes using semaphores that ensure mutual exclusion. CO3 [7]

OR

3(b') What is deadlock? Describe the four conditions that when occur simultaneously can give rise to a deadlock. Examine how each of these conditions are avoided in the deadlock avoidance algorithm. CO3 [7]

4(a) In a certain system with virtual memory, page references are made in the following order: CO4 [8]

1, 0, 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3, 2, 1, 2, 0, 1, 7

Assuming three frames, which are initially empty, compute the number of page faults for the following page replacement algorithms:

- (i) Least recently used (LRU)
- (ii) Optimal (OPT)

OR

4(a') Consider a disk with 200 cylinders numbered 0 to 199. The queue of I/O requests is for blocks on the following cylinders: CO4 [8]

99, 184, 35, 124, 16, 128, 66, 68

in that order. If the head is currently positioned at cylinder 50 and is moving towards cylinder 199, what is the total head movement (in number of cylinders) for following disk scheduling algorithms:

- (i) Shortest seek-time first
- (ii) C-SCAN

4(b) Draw the diagram of paging hardware with translation look-aside buffer (TLB). Explain the diagram. CO4 [7]

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2023-2024

B.TECH. (AUTUMN SEMESTER) EXAMINATION

MEH-3450: ENGINEERING ECONOMY &amp; MANAGEMENT

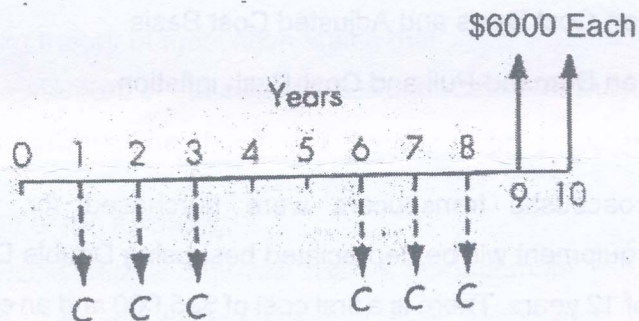
(COMPUTER/ARTIFICIAL INTELLIGENCE/CHEMICAL/PETROCHEMICAL ENGINEERING AND FOOD TECHNOLOGY)

Maximum Marks: 60

Duration: Two Hours

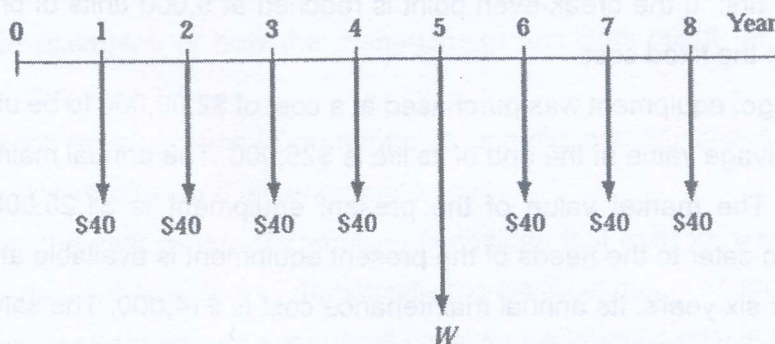
All questions are compulsory.  
Assume data suitably, if required.

- 1(a) Write one practical implication of the Equilibrium Point on the supply-demand curve. [CO1] [01]
- 1(b) On the Cost-Revenue Curve, show the regions of Profit and Loss. [CO1] [01]
- 1(c) Write in brief, how the equilibrium point changes if variable cost is decreased. [CO1] [02]
- OR
- 1(c') Differentiate between Monopoly and Oligopoly. [CO1] [02]
- 1(d) Differentiate between Nominal and Effective Interest Rates. [CO1] [02]
- 1(e) From the cash flow diagram, find the value of C (in \$) that will establish the economic equivalence between the deposit series and the withdrawal series at an interest rate of 8% compounded annually. [CO1] [04]



OR

- 1(e') For the cash flow diagram shown, determine the value of W that will render the equivalent future worth in 8 years equal to \$500 at an interest rate of 10% per year. [CO1] [04]

 $i = 10\%$  per year

Contd...2

1(f) Two alternative machines are being considered for a manufacturing process. Machine 'A' has a first cost of \$75,200 and its salvage value at the end of 6 years of estimated service life is \$21,000. The operating costs of this machine are estimated to be \$6,800 per year. Extra income taxes are estimated at \$2,400 per year. Machine 'B' has a first cost of \$44,000 and its estimated salvage value at the end of 6 years' of service is estimated to be negligible. The annual operating costs will be \$11,500. Compare these two alternatives by the present worth method at  $i=13\%$  per year. [CO1] [05]

OR

1(f) The purchase of a truck with an operator's platform on a telescoping hydraulic boom will reduce labour costs for sign installations by \$15,000 per year. The price of the boom truck is \$ 93,000 and its operating costs will exceed those of present equipment by \$250 per month. The resale value is expected to be \$18,000 in 8 years. Should the boom truck be purchased when the current available interest rate is 7%? [CO1] [05]

2(a) Define "Profitability Index" in the context of B/C Analysis. [CO2] [01]

2(b) Define Debt-Equity Ratio. [CO2] [01]

2(c) Differentiate between Cost Basis and Adjusted Cost Basis. [CO2] [01]

2(c) Differentiate between Demand-Pull and Cost-Push inflation. [CO2] [02]

2(d) On the Cost-Volume curve, how the breakeven point can be lowered? [CO2] [02]

2(e) Underwater electroacoustic transducers were purchased for use in SONAR applications. The equipment will be depreciated best using Double Declining Balance Method over a life of 12 years. There is a first cost of \$25,000 and an estimated salvage of \$2500. Calculate the depreciation and book value for 1<sup>st</sup> & 4<sup>th</sup> years. [CO2] [03]

OR

2(e') For a manufacturing firm, when the volume of production is 3,000 units, the average cost is \$4 per unit and when the volume of production is 4,000 units, the average cost is \$3.50 per unit. If the break-even point is reached at 5,000 units of production and sale, find out the fixed cost. [CO2] [03]

2(f) Two years ago, equipment was purchased at a cost of \$2,00,000 to be useful for eight years. Its salvage value at the end of its life is \$25,000. The annual maintenance cost is \$25,000. The market value of the present equipment is \$1,20,000. Now, new equipment to cater to the needs of the present equipment is available at \$1,50,000 to be useful for six years. Its annual maintenance cost is \$14,000. The salvage value of the new equipment is \$20,000. Using an interest rate of 12%, find whether it is worth replacing the present equipment with the new equipment. [CO2] [05]

OR

Contd... 3.

2(f) In the past, the Afram Foundation has awarded many grants to improve the living and medical conditions of people in war-torn and poverty-stricken countries throughout the world. In a proposal for the foundation's board of directors to construct a new hospital and medical clinic complex in a deprived central African country, the project manager has developed some estimates. These are developed in a manner that does not have a major negative effect on prime agricultural land or living areas for citizens. [CO2] [05]

*Award amount:* \$20 million (end of) first year, decreasing by \$5 million per year for 3 additional years; local government will fund during the first year only.

*Annual costs:* \$2 million per year for 10 years, as proposed.

*Benefits:* Reduction of \$8 million per year in health-related expenses for citizens.

*Disbenefits:* \$0.6 million per year for the removal of arable land and commercial districts.

Use the conventional and modified B/C methods to determine if this grant proposal is economically justified over a 10-year study period. The foundation's discount rate is 6% per year.

3(a) *Fill in the blanks* [CO3] [1x3]

- i) The Herzberg theory of motivation states that.....
- ii) .....is a statement of the organization's fundamental purpose.
- iii) Power granted through the organizational hierarchy is called .....

3(b) *Answer any TWO of the following:* [CO3] [2x2]

- i) Draw and define wide and narrow span of management.
- ii) Define organizational goals? What is their importance in the management process?
- iii) Differentiate between line and staff authority with suitable examples.

3(c) *Answer any TWO of the following:* [CO3] [4x2]

- i) What are the fundamental functions that comprise the management process? Describe examples of how the management functions might be performed in different sequences.
- ii) What is job specialization? Enumerate its benefits and limitations. Differentiate between job rotation and job enlargement.
- iii) What are the various decision-making conditions that exist for a manager while taking a decision? Explain systematically the classical model of decision-making. What assumptions should a manager consider while adopting this model?

Contd...4.

## 4(a) Fill in the blanks:

[CO4] [1x3]

- i) A list of important managerial positions in the occupation, who occupies it, how long he/she will remain in position and who is/will be a qualified replacement is known as .....
- ii) The four P's of marketing mix are .....
- iii) ..... is a business that transcends national boundaries and is not committed to a single host country.

4(b) Answer any **TWO** of the following:

[CO4] [2x2]

- i) Differentiate between Q/R inventory system and periodic inventory system.
- ii) Demand for part number 1012 was 210 in January, 100 in February and 150 in March. The forecast for January was 140 units. With a smoothing constant of 0.30 and using first order exponential smoothing, what is the April forecast?
- iii) What is a "Market"? List the types of markets that are used by sellers and buyers in a modern exchange economy.

4(c) Answer any **TWO** of the following:

[CO4] [4x2]

- i) What procedures do the human resource managers adopt while planning for human resources? How are the forecast and human resource demand and supply matched? Explain.
- ii) Describe the four basic levels of international business activity. Do you think any organization will achieve the fourth level? Why?
- iii) Define Quality. Discuss the two aspects of quality. Name some quality control tools and explain any one of them in detail.

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