Paper -17 -Strategic Performance Management
Section -A
[Question 1 and 2 are compulsory and any 3 from the rest]

1. Whirlpool Corporation is a leader of the $100 billion global home appliance industry. Ranked sixth in the electronics industry list of FORTUNE magazine's "World's Most Admired Companies", Whirlpool Corporation is a Fortune 500 company and the world's leading manufacturer and Marketer of major home appliances. Annual sales are approximately $19 billion, and there are 70,000 employees, with 69 manufacturing and technology research centers around the world.

Founded in 1911, the company markets Whirlpool, Maytag, Kitchen Aid, Jenn-Air, Amana, Brastemp, Consul, Bauknecht and other major brand names to consumers in most countries around the world. Whirlpool manufactures appliances across all major categories, including fabric care, cooking, refrigeration, dishwashers, countertop appliances, garage organization and water filtration. Whirlpool is committed to a brand value-creation strategy—focusing on innovation, cost Productivity, product quality and consumer value. The company continues to improve its global Operating platform to ensure it is the best-cost and best-quality appliance manufacturer Worldwide. Its supply chain has been transformed to better deliver products to trade customers and consumers. The benefits of actions are evident through a stronger network, increased efficiencies and timely deliveries. Whirlpool Corporation is committed to building products which consumers around the world can depend upon to meet their daily needs. This commitment to quality begins in the concept stages and continues throughout the lifetime of the appliance. The result of these efforts is a sustainable and competitive advantage for the company.

Globally, Whirlpool Corporation manufactures products using principles of lean manufacturing and operational excellence to ensure continuous improvement of processes and to produce products that meet the company's high-quality standards. At Whirlpool, there is a constant focus on seeking out new and unique ways to improve the function, performance and Sustainability of products.

After acquiring the Maytag Corporation on March 31, 2006, Whirlpool Corporation became the largest home appliance maker in the world.

A merger with Maytag added another layer of complexity to Whirlpool's efforts to manage sales, orders, and cash flow. Brian Hancock, VP Supply Chain, talks about how this was achieved. Until recently, Whirlpool's strategic focus was on its products and brands. In recognition of environmental changes (customer needs in particular) attention was shifted to their supply chain and how best to manage it. The need to focus on the supply chain was also instigated by major internal and organizational changes (the merger with Maytag). Furthermore it was recognized that two issues required attention: 1) the desire for trade partners to hold lots of inventory (which impacted upon cash flows) 2) balancing number one with customers needing their products quickly. One of the goals constraining the redesign of their supply chain was to ensure a customer order could be fulfilled and delivered to the customer within 48hrs. The company set about its operations/ supply chain strategy with the aim of improving cash flow, reducing costs and providing the right service to customers.

The first aspect of their strategy was the order process. Process, technology and inventory changes were made. Systems required replacement and integration with Maytag systems. Overall, there was a need to improve visibility within the supply chain.

Secondly, the company rationalized facilities, reducing the number of buildings from 184; they eliminated 100 buildings and consolidated major warehouses into 10 regional distribution centers. This resulted in cost savings of over $60 Million.

Thirdly, they optimized supply and demand, with changes to demand planning models and Software and integration with upstream suppliers.

Required:
   (i)   Describe objectives of Supply Chain Management.
   (ii) Importance of Supply Chain Management.
   (iii) Describe the challenges faced by the company: What were the drivers for change to the supply chain?

(iv) What are the benefits of change to the supply chain?
(v) Describe the Whirlpool strategy.   [3x5 = 15]

Answer of 1:

(i) **Objective of Supply Chain Management:**

(a) Supply Chain Management takes into consideration every facility that has an impact on cost and plays a role in making the product conform to customer requirements: from supplier and manufacturing facilities through warehouses and distribution centers to retailers and stores.

(b) The Supply Chain Management is to be efficient and cost effective across the entire system; total system wide costs from transportation and distribution to inventories of raw materials, work – in-progress and finished goods are to be minimized.

(c) Finally, Supply Chain Management revolves around efficient integration of suppliers, manufacturers, warehouses and stores; it encompasses the firm's activities at many levels, from the strategic level through the tactical to the operational level.

(ii) In the ancient Greek fable about the tortoise and the hare, the speedy and overconfident rabbit fell asleep on the job, while the "slow and steady" turtle won the race. But in today's demanding business environment, "slow and steady" won't get you out of the starting gate, let alone win any races. Managers these days recognize that getting products to customers faster than the competition will improve a company's competitive position. To remain competitive, companies must seek new solutions to introduce Supply Chain Management issues. Companies must face corporate challenges that impact Supply Chain Management such as reengineering, globalization and outsourcing.

Why is it so important for companies to get products to their customers quickly? Faster product availability is key to increasing sales, says R. Michael Donovan of Natick, Mass., a management consultant specializing in manufacturing and information systems. "There's a substantial profit advantage for the extra time that you are in the market and your competitor is not," he says. "If you can be there first, you are likely to get more orders and more market share." The ability to deliver a product faster also can make or break a sale. "If two alternatives products appear to be equal and one is immediately available and the other will be available in a week, which would you choose? Clearly, **Supply Chain Management has an important role to play in moving goods more quickly to their destination."**

(iii) Until recently, Whirlpool's strategic focus was on its products and brands. In recognition of environmental changes (customer needs in particular) attention was shifted to their supply chain and how best to manage it. The need to focus on the supply chain was also instigated by major internal and organizational changes (the merger with Maytag). Furthermore it was recognized that two issues required attention: 1) the desire for trade partners to hold lots of inventory (which impacted upon cash flows) 2) balancing number one with customers needing their products quickly. One of the goals constraining the redesign of their supply chain was to ensure a customer order could be fulfilled and delivered to the customer within 48hrs. The company set about its operations/ supply chain strategy with the aim of improving cash flow, reducing costs and providing the right service to customers. A merger with Maytag added another layer of complexity to Whirlpool's efforts to manage sales, orders, and cash flow. Brian Hancock, VP Supply Chain, talks about how this was achieved.

(iv) To gain competitive advantage, reduced costs, improved inventory management, improved customer satisfaction and improved cash flow.

(v) The first aspect of Whirlpool's strategy was the order process. Process, technology and inventory changes were made. Systems required replacement and integration with Maytag systems. Overall, there was a need to improve visibility within the supply chain.
Secondly, the company rationalized facilities, reducing the number of buildings from 184; they eliminated 100 buildings and consolidated major warehouses into 10 regional distribution centers. This resulted in cost savings of over $60 Million.
Thirdly, they optimized supply and demand with changes to demand planning models and Software and integration with upstream suppliers.

2. Taxmann Allied Services is a leading publisher specializing in books on Indian taxation and corporate laws, accounting and auditing, banking, finance and management. It also prints a vast array of journals, web-based products and legal databases on DVDs.

Until 2012, Taxmann did not have any solution to automate and manage sales or service processes. "Our sales, service and marketing teams managed customer information such as call and comments in a diary or at times in Excel worksheets, based on personal preferences," recalls Sumita Sharma, Head – Customer Care, Taxmann. The result was either duplication or data loss. Disorganized tracking and monitoring made the sales cycle longer than anticipated, thus resulting in a higher cost of sales and poor closure rate.

Taxmann also offers online subscription to journals and books and other content. Previously, if a customer contacted its call center, the representative did not have sufficient information to handle the calls effectively. Even simple issues such as activation, renewal and access, took time to resolve. In addition, there was no provision to log the customer and call details, or record the interaction. "Manual routing of calls, high wait time, and finding the right resources to resolve issues was a challenge. Resolution took 3-7 days, resulting in customer dissatisfaction," says Vishal Gambhir, Team Lead – Customer Care, Taxmann. Sometimes customers would abandon the call due to the long wait time and there was no way to identify repeat callers.
The company wanted a robust and centralized Customer Relationship Management (CRM) solution that would help optimize business processes, effectively plan and track sales activities to shorten the sales cycles, increase closure rates and provide quality services to its customers, thus leading to customer satisfaction.

Taxmann evaluated several CRM solutions available in the market, including Sage, Zoho, Salesforce.Com, Microsoft Dynamics CRM and Sugar CRM.
Taxmann approached Godrej Infotech, a Microsoft Gold Certified Partner to implement the solution because of its experience, expertise and on-time delivery record.

After much analysis, the team opted for the Microsoft Dynamics CRM 2011 solution. "It was imperative that the solution proposed consolidate all of the customer data into a single system and reduces overheads, duplication and rework," says Hemant Savla, Delivery Manager, Godrej Infotech."At the same time, integration with other existing applications was a must." Out-of-the-box features of Microsoft Dynamics CRM and integration abilities met all Taxman's requirements.

The deployment started in October 2012 and the solution went live in less than five months with all the three modules, Sales, Service and Marketing for 50 concurrent users. In March 2013, Taxmann started using its CRM solution at the head office and its two customer call centers in Delhi. It purchased 50 concurrent user licenses.

Taxmann now defines marketing campaigns, and assigns employees to specific customers. All employees add updates to the CRM solution, for example, sales persons will update leads and opportunities in Dynamics CRM. This generates a 360-degree view of the customers. A salesperson can also track a customer's preferences, such as the preferred mode of communication, and the type of information and offers he/she would like to receive. This information helps the marketing team to deliver the right information via the right touch point to the customer. Taxmann develops new strategies based on the information available in Dynamics CRM to cross-sell and up-sell its products and services, thus increasing revenue.

Godrej Infotech also customized and integrated Dynamics CRM with third-party applications to fulfill unique business requirements. "Integration with SMS and email helps us to stay connected with our customers on their mobile phones," says Vishal. Computer Telephony Integration (CTI) routes calls immediately to the technical team to resolve queries. If required, agents escalate the queries from one office to another, thus giving immediate response to customers and ensuring satisfaction. Call wrap-up capability for managing post-call operations in Dynamics CRM, such as adding notes, activity and case management helps the Taxmann management to understand its customers better.

Godrej Infotech configured the master data management, that set the policies, governance and management of the master data. In addition, it integrated Microsoft Dynamics NAV, the ERP solution at Taxmann with Dynamics CRM.

"All the requisition orders and sales orders from Dynamics CRM automatically flow into Dynamics NAV and are added to the master data," states Sunita Singh, ERP Head, Taxmann. For example, an employee can use the customer information that is in Microsoft Dynamics NAV, which is synchronized with Dynamics CRM, to fill in an order form that a salesperson creates in Microsoft Dynamics CRM. "It automatically synchronizes a customer's account, contact, product, sales order and invoice information in both the applications, thus eliminating duplication of data."

The solution also provides meaningful charts and dashboards, culling out useful reports using tools such as SQL Server Reporting Services (SSRS) and SQL Server Integration Services (SSIS – for CTI reports) and creating customized forms for individual customers. Additionally, it offers tools to improve its ability to predict market trends and requirements.

Taxmann plans to integrate its website with the solution in the near future. This will assist in capturing leads and opportunities from the website as well as service requests.

Benefits
Microsoft Dynamics CRM consolidated information in a centralized system giving a precise 360-degree view of every customer. It has effectively mitigated business challenges faced earlier. "We have improved the visibility of information and processes for more predictable and manageable business operations," says Sumita.
- (i) Improves Collaboration
- (ii) Enhances Customer Service
- (iii) Increase in Revenue
- (iv) Increases Efficiency

Required:
- (i) Define the Customer Relationship Management.
- (ii) Describe the objectives of the using of CRM applications.
- (iii) What are problem faces by the Taxmann before implementing the Customer Relationship?
- (iv) What are the steps are taken by the Taxmann to solve the problem?
- (v) What are the facilities getting from implementation of Customer Relationship Management? [3x5 =15]

Answer of 2:
- (i) There are as many definitions for CRM as there are opinions as to what is going to happen in the stock market on the next day. At its basic core, CRM entails initiatives

that surround the customer side of the business. An example is initiatives wrapped around the customers in an effort to increase sales, improve customer service, add market share, enhance customer loyalty and reduce operating costs of sales and service. At its more formal definition, CRM is a business strategy comprised of process, organizational and technical change whereby a company seeks to better manage its enterprise around its customer behaviors. It entails acquiring and deploying knowledge about customers and using this information across the various customers touch points to increase revenue and achieve cost reduction through operational efficiencies.

(ii) **Objectives for using CRM applications**

Objectives of using CRM applications, defined in the following line:

(a) To support the customer services
(b) To increase the effectiveness of direct sales force.
(c) To support of business to business activities.
(d) To support of business to consumer activities.
(e) To manage the call center.

(iii) Until 2012, Taxmann did not have any solution to automate and manage sales or service processes. They managed customer information such as call and comments in a diary or at times in Excel worksheets, based on personal preferences. The result was either duplication or data loss. Disorganized tracking and monitoring made the sales cycle longer than anticipated, thus resulting in a higher cost of sales and poor closure rate.

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(v) Microsoft Dynamics CRM consolidated information in a centralized system giving a precise 360-degree view of every customer. It has effectively mitigated business challenges faced earlier.

> **(a)** Improves Collaboration
> **(b)** Enhances Customer Service
> **(c)** Increase in Revenue
> **(d)** Increases Efficiency

3.(a) The operating performance of the three division of ABC Company for 2012 is as follows:

Particulars	Division A (₹)	Division B (₹)	Division C (₹)
Sales	38,00,000	1,70,00,000	2,00,00,000
Operating Profit	2,00,000	5,00,000	10,00,000
Investment	20,00,000	62,50,000	80,00,000

(i) Using the operating profit margin percentage as the criterion, which is the most profitable division?

(ii) Using the rate of return on investment as the criterion, which is the most profitable division?

(iii) Which of the two measures do you think gives the better indication of overall operating performance? Explain your reasoning.

(b) Explain the objectives of transfer pricing.   [(3+2+2)+3]

Answer of 3:

(a) The Return on Investment (ROI). Profit margin percentage and asset turnover ratio of the three divisions are as follows.

	Return on Investment =	Profit Margin Percentage x	Asset Turnover ratio
Division A:	$\frac{₹2,00,000}{₹20,00,000}$ = 10%	= $\frac{₹2,00,000}{₹38,00,000}$ = 5.26%	x $\frac{₹38,00,000}{₹20,00,000}$ 1.9
Division B:	$\frac{₹5,00,000}{₹62,50,000}$ 8%	= $\frac{₹5,00,000}{₹1,70,00,000}$ 2.94%	x $\frac{₹17,00,000}{₹62,50,000}$ 2.72
Division C:	$\frac{₹10,00,000}{₹80,00,000}$ 12.5%	= $\frac{₹10,00,000}{₹2,00,00,000}$ 5%	x $\frac{₹2,00,00,000}{₹80,00,000}$ 2.5

(i) Using the profit margin percentage, the ranking of the divisions are Division A, Division C, and Division B.

(ii) Using ROI, the ranking of divisions are Division C, Division A, and Division B.

(iii) The ROI is a better measure of overall performance because it relates profits to the investments, or capital, requires more capital to generate sales than did division C. Thus its overall profitability is less. Note that division B has the largest asset turnover ratio. However, it generates the smallest amount of net income per Rupee of sales, resulting in the lowest ROI of the three divisions.

(b) The issue of transfer pricing acquires added significance when accounting is to be used for the purpose of divisional performance measurement. The major significance of transfer pricing is that it will be used to measure notional sales of one division, which uses the transferred output as its input. Thus transfer price used in the organization will have significant effect on the financial performance of, different divisions. This brings forth the need for establishing a transfer price free from all biases. It has to be equitable as possible as to the different divisions in the organization.

The determination of an appropriate transfer price is one of the major problems of responsibility centers. The implication of the transfer price is that for the selling division (the division goods/services are being transferred) it is a source of revenue, whereas, for the buying division (the division which is receiving/acquiring the goods/services) it is an element of cost. It will, therefore, have significant bearing on the revenues, costs, and profits of responsibility centers.

Any Transfer Pricing System Should Aim to

» Ensure that resources are allocated in an optimal manner

» Promote goal congruence

» Motivate divisional managers

» Facilitate the assessment of management performance

» Retain divisional autonomy.

There are varieties of transfer pricing methods but in order to assess the validity and acceptability of different transfer pricing methods, the criteria generally used are -

In the first place the transfer price should be objectively determinable.

Secondly, it should be equal to the value of the intermediate products being transferred that is the transfer price should compensate the transferring division and charge the buying acquiring division in keeping with the value of the functions performed and/or the value of the product exchanged.

Finally, it should be compatible with the policy that maximizes attainment of company goals and evaluation of segment performance.

4. (a) List a few business applications of Activity Based Management.

(b) B manufacturing company sells its product at ₹ 1,000 per unit. Due to competition, its competitors are likely to reduce price by 15%. B wants to respond aggressively by cutting price by 20% and expects that the present volume of 1,50,000 units p.a. will increase to 2,00,000 units. B wants to earn a 10% target profit on sales. Based on

Particulars	Existing(₹)	Target(₹)
Direct Material Cost P.U.	400	385
Direct manufacturing labour P.U.	55	50
Direct machinery costs P.U	70	60
Direct manufacturing costs P.U	525	495
Manufacturing Overheads :		
No. of Orders (₹ 80 per order)	22,500	21,250
Testing hours (₹ 2 per hour)	45,00,000	30,00,000
Units reworked (₹100 per unit)	12,000	13,000

Manufacturing overheads are allocated using relevant cost drivers. Other operating costs per unit for the expected volume are estimated as follows:

Research and design	₹50
Marketing and Customer	₹130
	₹ 180

Required:
(i) Calculate target costs per unit and target costs for the proposed volume showing break up of different elements.
(ii) Prepare target product profitability statement.   [5+5]

Answer of 4:

(a) Business Applications of ABM
   (i) **Cost Reduction:** ABM helps the Firm to identify opportunities in order to streamline or reduce the costs or eliminate the entire activity, especially NVA activities. It is useful in

identifying and quantifying process waste, leading to continuous process improvement through continuous cost reduction.

(ii) **Activity Based Budgeting:** Activity Based Budgeting analyses the resource input or cost for each activity. It provides a framework for estimating the amount of resources required in accordance with the budgeted level of activity. Actual results can be compared with budgeted results to highlight (both in financial and non-financial terms) those activities with major discrepancies for potential reduction in supply of resources. It is a planning and control system, which supports continuous improvement.

(iii) **Business Process Re-Engineering (BPR):** BPR is the analysis and redesign of workflows and processes in a Firm, to achieve dramatic improvement in performance, and operational excellence. A business process consists of linked set of activities, e.g. purchase of materials is a business process consisting of activities like Purchase Requisition, Identifying Suppliers, preparing Purchase Orders, mailing Purchase Orders and follow up. The process can be reengineered by sending the production schedule direct to the suppliers and entering into contractual agreement to deliver materials according to the production schedule.

(iv) **Benchmarking:** It involves comparing the Firm's products, services or activities with other best performing organizations, either internal or external to the Firm. The objective is to find out how the product, service or activity can be improved and ensure that the improvements are implemented.

(v) **Performance Measurement:** Activity performance measures consist of measures relating to costs, time quality and innovation. For achieving product quality, some illustrative performance measures are -

Area	Measures
Quality of purchased component	Zero Defects
Quality of output	Percentage yield
Customer Awareness	No. of orders, no. of complaints

(b)
(i)

Target selling price : ₹1,000 less 20%	₹ 800
Less: Target profit margin (10%)	₹80
Target costs per unit	₹720

The break-up of ₹ 720 per unit is as follows:

Target Costs per unit

Particulars		Per unit (₹)
Direct materials		385
Direct manufacturing labour		50
Direct machining costs		60
Direct manufacturing costs		495
Add: Manufacturing overheads:		
Ordering and receiving (21,250 x ₹80)÷2,00,000	8.50	
Testing and inspection (30,00,000 x ₹2) ÷ 2,00,000	30.00	
Rework (13,000 x ₹100) ÷2,00,000	6.50	
		45
Total manufacturing costs		540
Other operating costs:		

Research and Design	50	
Marketing and Customer service	130	180
Full Product Costs		720

(ii) Target Product Profitability

Particulars	Per unit (₹)	2,00,000 units (₹)
1. Sales	800	16,00,00,000
2. Costs of goods sold:		
Direct Materials	385	7,70,00,000
Direct labour	50	1,00,00,000
Direct Machining Costs	60	1,20,00,000
	495	9,90,00,000
Manufacturing overheads	45	90,00,000
	540	10,80,00,000
3.Gross margin (1-2)	260	5,20,00,000
4. Operating costs:		
Research and Design	50	1,00,00,000
Marketing and customer service	130	2,60,00,000
	180	3,60,00,000
5.Operating profit (3-4)	80	1,60,00,000

5 (a) Two firms are competing for business under the conditions so that one firm's gain is another firm's loss. Firm A's pay-off matrix is given below:

		FirmB	
	No advertising	Medium advertising	Heavy advertising
No advertising	10	5	- 2
Firm A Medium advertising	13	12	15
Heavy advertising	16	14	10

Suggested optimum strategies for the two firms and the net outcome thereof.

(b) "Normally when new Investments have the same risk as existing operations, the discount rate applied is the average cost of capital of the operations, If the risk of the new project is greater………………" – Explain the above statement.   [5+5]

Answer of 5:

(a) Clearly, the first column is dominated by the second column as all the elements of the first column are greater than elements of second column. Thus eliminating first column. We get

		Firm B	
		Medium Advertising, B_2	Heavy Advertising, B_3
No Advertising	A_1	5	-2
Firm A Medium advertising	A_2	12	15
Heavy advertising	A_3	14	10

Again, first row is dominated by second and third row as all the elements of first row are less than the respective elements of second, and their row. Hence eliminating first row, we obtain the following 2 x 2 pay-off matrix.

		Firm B	
		Medium Advertising, B_2	Heavy Advertising, B_3
Firm A	Medium advertising, A_2	12	15
	Heavy advertisin, A_3	14	10

The reduced 2 x 2 payoff matrix also does not have the saddle point. Thus, both the Firms A and B use mixed strategies.

For Firm A. Let p_2 and p_3 be probabilities of selecting strategy A_2 (Medium advertising) respectively. Then the expected gain to Firm A when Firm B uses its B_2 and B_3 strategies is given by:
$12p_2 + 14p_3$ and $15p_2 + 10p_3$; $p_2 + p_3 = 1$

For Firm A, the probability p_2 and p_3 should be such that expected gains under both conditions are equal, i.e.,
$12p_2 + 14p_3 = 15p_2 + 10p_3 => 12p_2 + 14(1 - p_2) = 15p_2 + 10(1 - p_2)$

$$7p_2 = 4 => p_2 = \frac{4}{6} \text{ and } p_3 = 1 - p_2 = \frac{3}{7}.$$

For Firm B. Let q_2 and q_3 be probabilities of selecting strategies B_2 (Medium advertising) and strategy B_3 (Heavy advertising) respectively. Then the expected loss to Firm B when Firm A uses its B_2 and B_3 strategies should be:
$12q_2 + 15q_3 = 14q_2 + 10q_3$; $q_2 + q_3 = 1$
$=> 12q_2 + 15(1 - q_3) = 14q_2 + 10(1 - q_2)$

$$\therefore 7q_2 = 5 => q_2 = \frac{5}{7} \text{ and } q_3 = 1 - q_2 = \frac{2}{7}$$

The expected gain and loss to Firm A and Firm B can be computed as shown below:

Expected gain to Firm A : $\quad 12p_2 + 14p_3 = 12 \times \frac{4}{7} + 14 \times \frac{3}{7} = \frac{90}{7}$

Expected gain to Firm B : $\quad 12q_2 + 15q_3 = 12 \times \frac{5}{7} + 15 \times \frac{2}{7} = \frac{90}{7}$

Hence the optimum strategies for the two firms are:

$$S_A = \begin{bmatrix} \underset{\text{No advertising}}{0} & \underset{\text{Medium advertising}}{\frac{4}{7}} & \underset{\text{Heavy advertising}}{\frac{3}{7}} \end{bmatrix}$$

$$S_B = \begin{bmatrix} \underset{\text{No advertising}}{0} & \underset{\text{Medium advertising}}{\frac{5}{7}} & \underset{\text{Heavy advertising}}{\frac{2}{7}} \end{bmatrix}$$

And the value of the game is V = $\frac{90}{7}$.

| | Firm B | |
| | Medium Advertising, B_2 | Heavy Advertising, B_3 |

Firm A $\begin{array}{c} A_2 \\ A_3 \end{array}$ $\begin{bmatrix} 12 & 15 \\ 14 & 10 \end{bmatrix}$ $14 - 10 = 4, \; P(A_2) = \dfrac{4}{4+3} = \dfrac{4}{7}$

$15 - 12 = 3, \; P(A_3) = \dfrac{3}{4+3} = \dfrac{3}{7}$

$15 - 10 = 5$ $14 - 12 = 2$

$P(B_2) = \dfrac{5}{5+2} = \dfrac{5}{7}$ $P(B_3) = \dfrac{2}{5+2} = \dfrac{2}{7}$

Hence, Firm, A should adopt strategies A_2 and A_3 with 57% of time and 43% of time respectively, (or with 57% and 43% probability on any one play of the game respectively). Similarly, Firm B should adopt strategies B_2 and B_3 with 71% of time and 29% of time respectively (or with 71% and 29% probability on any one play of the game respectively).

Expected gain of Firm A	Expected gain of Firm B
(i) $12 \times \dfrac{4}{7} + 14 \times \dfrac{3}{7} = \dfrac{90}{7}$ Firm B adopts B_2	(i) $12 \times \dfrac{5}{7} + 15 \times \dfrac{2}{7} = \dfrac{90}{7}$ Firm A adopts A_2
(ii) $15 \times \dfrac{4}{7} + 10 \times \dfrac{3}{7} = \dfrac{90}{7}$ Firm B adopts B_3	(ii) $14 \times \dfrac{5}{7} + 15 \times \dfrac{2}{7} = \dfrac{90}{7}$ Firm A adopts A_3

(b) Above statement explained about Risk Adjusted Discount Rate Method. This method is very much akin to certainty equivalent method that is more popular. This is due to the fact that quantification of the risk premium is more concrete in this method. Normally when new investments have the same risk as existing operations, the discount rate applied is the average cost of capital of the operations. If the risk of the new project is greater, then a formula is applied for the computation of the risk adjusted discount rate, as follows:

$r_p = r_f + n + d_p$

Where,

r_p = Risk adjusted discount rate for project 'p'

r_f = Risk free rate of interest

n = Premium for normal risk

d_p = Premium for additional risk differential for project 'p'

The risk premium so computed is based on the perception regarding the project risk and risk-return preference. Such premiums are normally calculated by comparing the returns obtained from different investments currently. The risk premium, normally varies between one per cent to 10 per cent, based on the risk assessment of such investments.

The offshoot of this method is the Risk Adjusted Return on Capital (RAROC). This computation is a risk-based profitability measurement framework for understanding the risk adjusted financial performance and providing an appropriate view. The RAROC can be represented as follows:

RAROC = Expected return/Economic capital or

RAROC = Expected return/Value at risk

6. (a) Answer any one

(i) A radio manufacturer produces 'x' sets per week at total cost of ₹ X² + 78x + 2500.

He is a monopolist and the demand function for his product is $x = \dfrac{(600 - p)}{8}$, when the

price is 'p' per set show that maximum net revenue is obtained when 29 sets are produced per week what is the monopoly price?

(ii) The demand function for particular commodity is $y = 15e^{\frac{-x}{5}}$ where 'y' is the price per unit and 'x' is the no. of units demanded, demanded, determines the price and quantity for which revenue is maximum.

(b) Target customers, Cost of the product, Market position of the firm, Distribution channel policy, Price elasticity of Demand – all are factors influencing the price of a product. Discuss each of the above factors. **[5+5]**

Answer of 6:

(a)

(i) Cost (C) = x^2 +78x+2500

Demand (D) X = (600 – P)/8

8x = 600 – P

∴P = 600 - $8x^2$

Total revenue per 'x' sets

Price x i.e., 600x – $8x^2$

Maximum revenue is obtains at MC = MR

Marginal Cost = $\dfrac{dc}{dx}$ = 2x +78 – (i)

Marginal revenue = $\dfrac{dr}{dx}$ = 600 – 16x – (ii)

Equity (i) & (ii)

2x +78 = 600 – 16x

= 18x = 522

∴X = $\dfrac{522}{18}$ = 29

Monopoly price 600 – 8x

600 -8 x29

  = 600 -232 = 368

(ii) Demand function y = $15 e^{\frac{-x}{5}}$

Total Revenue (R) = $15 x\ e^{\frac{-x}{5}}$

In order that Revenue is maximum $\dfrac{dR}{dx} = 0$

and $\dfrac{d^2R}{dx^2}$ = negative

$\dfrac{dR}{dx}$ = 15 (X x $e^{\frac{-x}{5}}$ x $\dfrac{1}{5}$ + $e^{\frac{-x}{5}}$ x 1)

= 15 ($e^{\frac{-x}{5}}$ - $\dfrac{xe^{\frac{-x}{5}}}{dx}$)

$$= 15e^{\frac{-x}{5}} (1 - \frac{x}{5}) = 0$$

$$= 1 - \frac{x}{5} = 0$$

i.e., $1 - \dfrac{x}{5}$

$$\therefore x = 5$$

$$\frac{d^2R}{dx^2} = 15 \left[\frac{x}{25} e^{-x/25} - \frac{e^{-x/5}}{5} - \frac{e^{-x/5}}{5} \right]$$

$$= 15 \left[\frac{x}{25} e^{-x/25} - \frac{2e^{-x/5}}{5} \right]$$

$$\therefore \frac{d^2R}{dx^2} \text{ at } x = 5 = 15 \left[\frac{1}{5e} - \frac{2}{5e} \right] = \text{-ve}$$

(b) **Factors Influencing Price of a Product:**
Generally, marketers consider the factors in setting price i.e. Target Customers, Cost of the Product, Competition, The law, Social Responsibility, Market Position of the Firm, Distribution Channel Policy, Price elasticity of Demand, Economic Environment etc. As required by the question we are discussing the following factors:

(i) **Target customers:** Price of product is depend on the capacity of buyers to buy at various prices, in other words, influence of price elasticity of demand will be examined.

(ii) **Cost of the Product:** Pricing is primarily based on, how much it costs to produce and market the product, i.e., both the production and distribution cost.

(iii) **Market Position of the Firm:** The position of the market may also influence the pricing decision of the firm. It is only why the different producers of identical products sell their products at different prices.

(iv) **Distribution Channel Policy:** The prices of products will also depend up the policy regarding distribution channel The longer the channel, the higher would be the distribution costs and consequently higher the prices.

(v) **Price elasticity of Demand:** Price elasticity refers to consequential change in demand due to change in price of the commodity. It is the relative responsiveness to the changes in price. As there an inverse relationship between price and demand for product, the demand will increase with fall in price.

Section – B
[Answer any one]

7. (a) Explain Technical and operational factors of E-commerce.
   (b) Discuss the term of Data Availability.
   (c) Explain the Statistical Process Control (SPC) methods.
   (d) "The MI is based on the concept of the Production function. This is a function of maximum possible production, with respect to a set of inputs pertaining to capital and labour" – Discuss it.
   (e) After adopting Total Productivity Maintenance, what types of benefit will your organization get?

[6+3+4+4+3]

Answer of 7:

(a) **Technical and Operational Factors of E-commerce**

(i) Protocol (Standards) Making Process

A well-established telecommunications and Internet infrastructure provides many of the necessary building blocks for development of a successful and vibrant e-commerce marketplace.

(ii) Delivery Infrastructure

Successful e-commerce requires a reliable system to deliver goods to the business or private customer.

(iii) Availability of Payment Mechanisms

Secure forms of payment in e-commerce transactions include credit cards, checks, debit cards, wire transfer and cash on delivery.

(iv) General Business Laws

The application of general business laws to the Internet will serve to promote consumer protection by insuring the average consumer that the Internet is not a place where the consumer is a helpless victim.

(v) Public Attitude to E-commerce

The public attitude toward using e-commerce in daily life is a significant factor in the success of ecommerce.

(vi) Business Attitude to E-commerce

The willingness of companies to move away from traditional ways of doing business and develop methods and models that include e-commerce is essential.

(b) **Data Availability**

Data availability is a term used by some computer storage manufacturers and storage service providers (SSPs) to describe products and services that ensure that data continues to be available at a required level of performance in situations ranging from normal through "disastrous." In general, data availability is achieved through redundancy involving where the data is stored and how it can be reached. Some vendors describe the need to have a data center and a storage-centric rather than a server-centric philosophy and environment.

In large enterprise computer systems, computers typically access data over high-speed optical fiber connection to storage devices. Among the best-known systems for access are ESCON and Fibre Channel. Storage devices often are controlled as a redundant array of independent disks (RAID). Flexibility for adding and reconfiguring a storage system as well as automatically switching to a backup or failover environment is provided by a programmable or manually-controlled switch generally known as a director.

Two increasingly popular approaches to providing data availability are the storage area network (SAN) and network-attached storage (NAS). Data availability can be measured in terms of how often the data is available (one vendor promises 99.999 per cent availability) and how much data can flow at a time (the same vendor promises 3200 megabytes per second).

(c) Statistical process control (SPC) monitors specified quality characteristics of a product or service so as:

To detect whether the process has changed in a way that will affect product quality and To measure the current quality of products or services.

- **Control** is maintained through the use of control charts. The charts have upper and lower control limits and the process is in control if sample measurements are between the limits.
- **Control Charts for Attributes**

P Charts - measures proportion defective.

C Charts - measures the number of defects/unit.

- **Control Charts for Variables**

X bar and R charts are used together - control a process by ensuring that the sample average and range remain within limits for both.

- **Basic Procedure**
    (i) An upper control limit (UCL) and a lower control limit (LCL) are set for the process.
    (ii) A random sample of the product or service is taken, and the specified quality characteristic is measured.
    (iii) If the average of the sample of the quality characteristic is higher than the upper control limit or lowers than the lower control limit, the process is considered to be "out of control".

(d) The **Malmquist Index** (MI) is a bilateral index that can be used to compare the production technology of two economies. It is named after Professor Sten Malmquist, on whose ideas it is based. It is also called the Malmquist Productivity Index.

The MI is based on the concept of the Production function. This is a function of maximum possible production, with respect to a set of inputs pertaining to capital and labour. So, if S_a is the set of labour and capital inputs to the production function of Economy **A, and Q** is the production function of Economy A, we could write **Q = f (S_a).**

While the production function would normally apply to an enterprise, it is possible to calculate it for an entire region or nation. This would be called the aggregate production function.

To calculate the Malmquist Index of economy A with respect to economy B, we must substitute the labour and capital inputs of economy A into the production function of B, and vice versa. The formula for MI is given below.

$$MI = \sqrt{(Q_1 Q_2) / (Q_3 Q_4)}$$

Where,

Q_1 = f_a (S_a)
Q_2 = f_a (S_b)
Q_3 = f_b (S_a)
Q_4 = f_b (S_b)

Note that the MI of A with respect to B is the reciprocal of the MI of B with respect to A. If the MI of A with respect to B is greater than 1, the aggregate production technology of economy A is superior to that of economy B.

(e) With the adoption of Total Productivity Maintenance at the enterprise level, your organisation would benefit from the following aspect:

- A set of new management goals will be developed by the Management, using the skills and training provided during the implementation of the TPM
- Team bonding and better accountability
- Improved quality and total cost competitiveness
- Productivity and quality team training for problem solving

- Earlier detection of factors critical to maintaining equipment "uptime"
- Measure impact of defects, sub-optimal performance, and downtime using OEE (Overall Equipment Effectiveness)
- Motivated people function better all the time

8.(a) "It may be useful for development organizations to consider the many issues involved before embarking on an e-commerce initiative, in relation to the organization's mandate, development goals, and organizational structure. The primary issues involved would include: (i) Resource Expansion, (ii) Capital Costs, (iii) Marketing etc" – Discuss the three points.

(b) Mention the characteristics of Data Warehouse. [12+8]

Answer of 8:

(a) It may be useful for development organizations to consider the many issues involved before embarking on an e-commerce initiative, in relation to the organization's mandate, development goals, and organizational structure. The primary issues involved would include:

- **Resource Expansion** – Is the main goal of selling goods and services online the generation of revenue to offset operational costs? If so, how much revenue does the organization expect/wish to generate? These strategic questions will allow the organization to assess how much funding will go toward e-commerce activities. If the organization is approaching e-commerce as a means of covering not only the costs of producing the goods and services and disseminating development-focused products, but wishes to expand its revenue base to support other project costs, then it may want to develop an e-commerce platform and strategy that can attract customers. The organization may have to approach e-commerce as a resource expansion activity that uses business strategies and a full marketing approach. This leads to the question of whether this fits in with the development mandate of the organization and its charitable organization status. Will e-commerce activities distort the tax-free status of the development organization? Is the organization liable in the case of legal conflicts? Most development organizations have already faced these questions if they sell publications and other products by "traditional" means.

- **Capital Costs** – How much funding is the organization willing to put into e-commerce activities? E-commerce platforms can be high priced, depending on the level of sophistication. A development organization undertaking e-commerce activities should consider whether it wants to incur higher costs, with the possibility of cost recovery from an expected higher level of sales. What are the possibilities of receiving financial assistance from donor agencies or partner organizations for this activity? Development organizations pursuing e-commerce activities may have to decide between varieties of options for their online selling activities, depending on their financial capacities. These options can be divided into 1) technical hardware and 2) site design and maintenance. The organization will have to decide whether it wants to invest in setting up its own in-house server, depending on the organization's size and computing requirements, or find a third party that is willing to host the site on its server. Is the third party another development-focused organization, or is it a private company/ISP? Regarding design and maintenance of the e-commerce site, is the organization able to hire in-house technical personnel to handle design, development, and maintenance, or is it more cost effective to hire an outside party to handle these tasks? Developing an e-commerce site that generates high levels of revenue will have to respond to the changes in e-commerce platforms in the commercial sector. The development organization may want to consider using security encryption software for credit card payment, increasing costs to an extent yet benefiting from increasing customer confidence in the transaction process. Will the site be eye-catching, with the hope of attracting customers, possibly increasing

site development costs for higher level graphics and design? Pan Partners currently do not have to bear all of the above-mentioned capital costs, but may one day have to consider them when they initiate an e-commerce site on their own.

- **Marketing** – As evident from the discussion above, a good marketing strategy forms the basis of the operational strategy, in order to attract customers to the e-commerce site and ensure a steady pattern of sales. Development organizations often need not employ capital-intensive marketing programs in order to have a successful marketing campaign. The marketing strategy can be divided into two main categories: 1) online markets and 2) offline markets.

(b) The Data Warehouse is a collection of integrated, subject-oriented databases designed to support the Decision-Support Functions (DSF), where each unit of data is relevant to some moment in time. A Data Warehouse includes the following categories of data, where the classification is accommodated to the time-dependent data sources:

(i) Old detail data
(ii) Current (new) detail data
(iii) Lightly summarized data
(iv) Highly summarized data
(v) Metadata (the data directory or guide).

To prepare these five types of elementary or derived data in a Data Warehouse, the fundamental types of data transformation are standardized. There are four main types of transformations, and each has its own characteristics:

(i) Simple Transformations - These transformations are the building blocks of all other more complex transformations. This category includes manipulation of data that is focused on one field at a time, without taking into account its values in related fields. Examples include changing the data type of a field or replacing an encoded field value with a decoded value.

(ii) Cleansing and Scrubbing - These transformations ensure consistent formatting and usage of a field, or of related groups of fields. This can include a proper formatting of address information, for example. This class of transformations also includes checks for valid values in a particular field, usually checking the range or choosing from an enumerated list.

(iii) Integration - This is a process of taking operational data from one or more sources and mapping it, field by field, onto a new data structure in the data warehouse. The common identifier problem is one of the most difficult integration issues in building a data warehouse. Essentially, this situation occurs when there are multiple system sources for the same entities and there is no clear way to identify those entities as the same. This is a challenging problem, and in many cases it cannot be solved in an automated fashion. It frequently requires sophisticated algorithms to pair up probable matches. Another complex data-integration scenario occurs when there are multiple sources for the same data element. In reality, it is common that some of these values are contradictory, and resolving a conflict is not a straightforward process. Just as difficult as having conflicting values is having no value for a data element in a warehouse. All these problems and corresponding automatic or semiautomatic solutions are always domain-dependent.

(iv) Aggregation and Summarization - These are methods of condensing instances of data found in the operational environment into fewer instances in the warehouse environment. Although the terms aggregation and summarization are often used interchangeably in the literature, we believe that they do have slightly different meanings in the data-warehouse context. Summarization is a simple addition of values

along one or more data dimensions; e.g., adding up daily sales to produce monthly sales. Aggregation refers to the addition of different business elements into a common total; it is highly domain-dependent. For example, aggregation is adding daily product sales and monthly consulting sales to get the combined, monthly total.

Section –C
[Answer any one of the following questions]

9. (a) "Risk management process refers to the process of measuring or assessing risk and then developing Strategies to manage risk. In the risk management, the following steps are taken up to minimize the risk"- Discuss the steps which are taken to minimize the risk

(b) There are various Strategic Decisions for Managing Risk. Describe those strategic decisions.

(c) Describe the Asset Liability Management Model in the perspective of Corporate Risk Management. **[5+9+6]**

Answer of 9:

(a) Risk management process refers to the process of measuring or assessing risk and then developing strategies to manage risk. In the risk management, the following steps are taken up to minimize the risk:

Step 1: Risk Identification and Assessment
This step involves event identification and data collection process. The institution has to put in place a system of capturing information either through key risk drivers (KRIs) or through a rating system. Once risks are identified, combine like risks according to the following key areas impacted by the risks — people, mission, physical assets, financial assets, and customer/stakeholder trust.

Step 2: Risk Quantification and Measurement
The next step is to Quantify and Measure risks. This means risks according to probability and impact. Various standard tools are used by financial institutions to measure risk and understand their impact in terms of capital or its importance to the organization through a scoring technique.

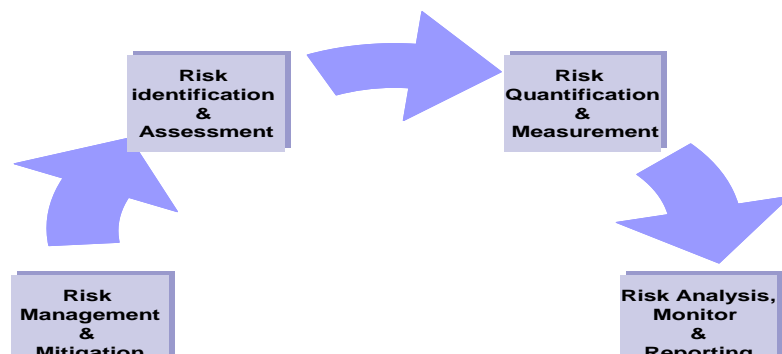**Step 3: Risk Analysis, Monitor and Reporting**
The next step is risk analysis, monitoring and reporting. This will help one to get the big picture and decided on the approach to risk management.

Step 4: Capital Allocation
Risk Analysis, Monitoring & Reporting sends information to the top management of the organization to take strategic decisions. Capital allocation plays key role in management decision making.

Step 5: Risk Management and Mitigation
After the above step, the last step is to make strategic decisions to manage the risk in order to mitigate the risk.

(b) **Strategic Decision for Risk Management**

Risk Handling: In ideal risk management, a prioritization process is followed whereby risks with the greatest loss and the greatest probability of occurring are handled first, and risks with lower probability loss are handled later.

Risk Reduction: This strategy is attempted to decrease the quantum of losses arising out of a risky happening e.g. earthquake, storm, flood etc. It involves methods that reduce severity of the loss arising from risk consequences. Risk reduction can be achieved through (a) loss prevention, and (b) loss control.

Risk Avoidance: This is prevention and a proven strategy. This strategy results in complete elimination of exposure to loss due to a specific risk. It may involve avoidance of an activity, which is risky. It includes deliberate attempt on part of the person taking risk decision not to perform an activity or not to accept a proposal, which is risk prone. This strategy can be approached in two ways: (a) Don't assume risk, and (b) Discontinue of an activity to avoid risk.

Risk Retention: This strategy is adopted when risk cannot be avoided, reduced or transferred. It involves accepting the loss when it occurs by taking risky proposal or risky assignment where there are no other alternatives to avoid risk. It can be a voluntary or involuntary action. When it is voluntary, it is retained through implied agreements. Involuntary retention occurs when the organization is unaware of the risk and faces it when it comes up.

Risk Transfer: It means causing another party to accept the risk, typically by contract. It involves a process of shifting risk responsibility on others. Insurance is one type of risk transfer, which is widely used in common parlance.

Risk Hedging: It is a systematic process of reducing risk associated with an investment proposal or in some other assignments where risk is inevitable i.e. the risk is of such nature that it cannot be avoided altogether.

Risk Diversification: It involves identifying both systematic and unsystematic risks. Systematic risk is inherent and is peculiar to the type of business/firm and can be reduced or diversified through functional level strategy. The unsystematic risk is external to the organization and is termed as 'market risk'. The identification of characteristics of market risk through statistical correlation 'beta, which is a measure of market risk, lends itself for manipulation through portfolio management. This strategy is followed in reduction of risk of single portfolio by investing in shares, debentures, bonds, treasury bills etc. to reduce overall risk of the portfolio.

Risk Sharing: Taking an insurance coverage for the exposure is the common method of sharing risk. By paying insurance premium, the company shares the risk with an insurance company. The insurance company can also share its risk with other insurance companies by doing reinsurance.

Risk Pooling: It is the process of identification of separate risks and put them all together in a single blanket, so that the monitoring, integrating or diversifying risk can be implemented.

(c) Risks encountered in portfolio management need to be addressed more emphatically. In passive portfolio management, normally the mean variance and mean absolute deviation are employed to arrive at an optimal fixed mix strategy. However, this method does not recognize the high volatility in financial markets and as such the volatility risk is not addressed. However, active portfolio management is more aggressive, and involves reviewing the initial investment strategy every time rebalancing of the portfolio is required. Carino and Turner (1998) present the superiority of dynamic asset allocation framework using stochastic programming applications. Any financial planning strategy should be such that the mix of asset classes in a portfolio is able to grow and satisfy future goals with the best possible returns. This is the crux of asset liability management.

Asset liability management applications with the aid of stochastic programming conceptualize the problem of creating a portfolio by allocating a set of assets. The investor needs to decide the three factors, namely:

- Amount of assets to buy
- Amount of assets to sell
- Amount of assets to hold

The indices are defined and the problem parameters and decision variables are set out so that the stochastic programming model can develop a solution.

In this deterministic model, uncertainty is introduced to take care of risk. A refinement to the deterministic model is to apply a more sophisticated technique for estimation of asset prices that takes into consideration any unusual occurrence in the market as well as volatility. Sub-models based on randomness are introduced into the programming to take care of the risk as well. The randomness introduced is able to generate a set of scenarios which can be incorporated into the optimization model.

This model can be further improved using a two-stage stochastic program because an investor tries to use this model for making a contingent decision involving future risk. The first stage involves fixing a time period for stage two observation followed by finally taking a decision. The observation part of it can be likened to a 'wait and see' period of observation.

Asset liability management model can also be conceptualized as a method to compute the matching of assets and liabilities to generate a cautious investment portfolio. The purpose of this model is to optimize risk-adjusted returns to the shareholders over a long run. Two approaches for matching assets and liabilities are as follows:

Duration: This is defined as a measure of price sensitivity in relation to interest rates. It refers to the weighted average maturity where the weights are applied in terms of present value. This can be represented by the following formula:

Modified duration =Duration / [1+ (Yield to maturity/Number of coupon payments per year)]

Convexity: This is defined as the change in duration corresponding to changes in yield as follows:

Convexity = $(P_+ + P_- - 2P_0)/ 2P_o ((\Delta i)^2)$

where

Δi = Change in yield (in decimals)

P_o = Initial price

P_+ = Price if yields increase by Δi

P_- = Price if yields decline by Δi

Combining convexity and duration is a good approach to examining the influence on change in yield on the market values of assets and liabilities.

The asset management model can also be employed to manage liquidity risk. Assets and liabilities can be arranged according to their maturity pattern in a time frame. Applying gap analysis, the differential between maturing assets and maturing liabilities are computed. If the gap is positive, then assets exceed liabilities; if it is negative, infusion of funds would be necessary either through sale of assets or creating new liabilities or a rollover of existing liabilities.

This model can also be applied to exchange rate risk management. Financial institutions match their assets and liabilities at a particular exchange rate. Fluctuations in the exchange rate obviously disturb the balance. This risk is corrected by matching the assets and liabilities in the same currency. The risk of foreign exchange borrowings can also be passed on to the lenders through foreign currency loans. The uncovered borrowings can be hedged through forward covers for the entire amount.

10.(a)"Symptoms are interrelated. The classic path to corporate failure starts with the company experiencing low profitability. This may be indicated by trends in the ratios for: (i) Profit margin,(ii) Return on Capital Expenditure and (iii) Return on Net Assets" – Discuss it.

(b) "Several techniques have been developed to help in prediction why companies fail." – Describe the Altman: Z Score Model in this regard.
(C) Explain the Neural Network (NN) under the Corporate Bankruptcy Prediction Models.
[5+10+5]

Answer of 10:
(a) There are three classic symptoms of corporate failure. These are namely:
   1. Low profitability
   2. High gearing
   3. Low liquidity

Each of these three symptoms may be indicated by trends in the company's accounts. Symptoms are interrelated. The classic path to corporate failure starts with the company experiencing low profitability. This may be indicated by trends in the ratios for:
• **Profit margin**
• **Return on Capital Expenditure**
• **Return on Net Assets**

A downward trend in profitability will raise the issue of whether and for how long the company can tolerate a return on capital that is below its cost of capital. If profitability problems become preoccupying, the failing of the company may seek additional funds and working capital by increasing its borrowings, whether in the form of short term or long-term debt. This increases the company's gearing, since the higher the proportion of borrowed funds, the higher the gearing within the capital structure. The increased debt burden may then aggravate the situation, particularly if the causes of the decreasing profitability have not been resolved.
The worsening profit situation must be used to finance an increased burden of interest and capital repayments. In the case of a publicly quoted company, this means that fewer and fewer funds will be available to finance dividend payments. It may become impossible to obtain external credit or to raise further equity funds.

(b) The Z-Score model is a quantitative model developed by Edward Altman in 1968, to predict bankruptcy or financial distress of a business. The Z-score is a multi variate formula that measures the financial health of a company and predicts the probability of bankruptcy within 2years. This model involves the use of a specified set of financial ratios and a statistical method known as a Multiple Discriminant Analysis. (MDA). The real world application of the Altman score successfully predicted 72% of bankruptcies two years prior to their failure.

The model of Altman is based on a linear analysis in which five measures are objectively weighted and summed to arrive at an overall score that then becomes the basis for classification of companies into one of the two a priori groupings that is bankrupt or non-bankrupt. These five indicators were then used to derive a Z-Score. These ratios can be obtained from corporations' financial statements.

The five Z-score constituent ratios are:
1. Working Capital/Total Assets (WC/TA):- a firm with negative working capital is likely to experience problems meeting its short-term obligations.
2. Retained Earnings/Total Assets: - Companies with this ratio high probably have a history of profitability and the ability to stand up to a bad year of losses.

3. Earnings Before Interest & Tax/ Total Assets: - An effective way of assessing a firm's ability to profit from its assets before things like interest and tax are deducted.
4. Market Value of Equity/ Total Liabilities: - A ratio that shows, if a firm were to become insolvent, how much the company's market value would decline before liabilities exceed assets.
5. Sales/Total Assets: - A measure of how management handles competition and how efficiently the firm uses assets to generate sales.

Based on the Multiple Discriminant Analysis, the general model can be described in the following form:
Z=1.2WC/TA + 1.4 RE/TE + 3.3 EBIT/TA + 0.6 MVE/TL + 1.0 SL/TA

Probability of failure according to the Z-Score result:

Z-Score	Probability of Failure
Less than 1.8	very High
Greater that 1.81 but less than 2.99	Not Sure
Greater than 3.0	Unlikely

Calculation of the Z-Score for a fictitious company where the different values are given to calculate the Z-Score.

Sales	25,678
Total Assets	49,579
Total liabilities	5,044
Retained earnings	177
Working Capital	-1,777
Earnings before interest and tax	2,605
Market value of Equity	10,098
Book value of Total Liabilities	5,044

The calculations of the ratios are as follows:
1. Working Capital/Total Assets (-1,777/ 49579) = -0.036
2. Retained Earnings/Total Assets (177/ 49579) =0.004
3. Earnings Before Interest & Tax/ Total Assets (2605/ 49579)= 0.053
4. Market Value of Equity/ Total Liabilities (10098/ 5044)= 2.00
5. Sales/Total Assets (25978/ 49579)=0.52

Thus according to the formula the answer should be:
Z=1.2(-0.036) + 1.4 (0.004) + 3.3 (0.053) + 0.6 (2.0) + 1.0(0.52)
Z= -0.04+ 0.01+0.17+1.20+0.52
Z=1.86

According to Altman, this company may or may not fail as it is greater than 1.81 but less than 2.99, which situates it neither on the safe side nor on the failure side.

(c) Although capable of outperforming human brain in basic arithmetic calculations, computers are certainly inferior when it comes to tasks involving symbolic recognition like signs of bankruptcy in a firm. Neural networks are enthused by biological works related to brain and its nervous system to triumph over this lack of computational efficiency in computers. Neural networks perform the classification task, in response to impending signals of financial health of a firm, in the way a brain would do for example in deciding whether the food is salty or sweet by its taste signal.
Human brain is made up of certain types of neurons (nerve cells), which is the base of neuroscience. Neurons, in neural networks, are called 'processing elements' or 'nodes'. Like real neurons, these nodes are connected to each other through 'weighted interconnections' (synapses in neuroscience terms). Nodes are organized in layers. Each node takes delivery of, joins, and converts input signals into a single output signal via

weighted interconnections. This output signal is accepted as the classifying decision if it satisfies the researcher; otherwise it is transmitted again as an input signal to many other nodes (possibly including itself). Process keeps going until satisfaction is gained from researchers' point of view.

Perhaps the major task of any neural network is to determine appropriate weights to interconnections of different nodes. Neural networks perform this task by a training process in which knowledge about the relationship between input and output signals is learned following certain principle. This knowledge produces a distinct structure of nodes (in one of the network layers called 'hidden layer') and connection weights, which correctly classifies the objects into their respective known groups. Technically, this process of mapping is termed as 'convergence'. Following a mathematical theorem, the network is always able to converge.

While predicting corporate bankruptcy, NN would take information on explanatory variables at input nodes via input layer. The hidden layer nodes, connected to input nodes through weighted interconnections, collect and process this information to suggest a probability of a firm getting failed or succeeded.