You will have to wait for 7.72 years.

6.11 Shyam borrows ₹ 80,000 for a musical system at a monthly interest of 1.25 percent. The loan is to be repaid in 12 equal monthly instalments, payable at the end of each month. Prepare the loan amortisation schedule.

Solution

The monthly instalment A is obtained by solving the equation:

$$80{,}000 = A \times \text{PVIFA}_{n=12,\, r=1.25\%}$$

$$80{,}000 = A \times \frac{1 - \frac{1}{(1+r)^n}}{r}$$

$$80{,}000 = A \times \frac{1 - \frac{1}{(1.0125)^{12}}}{.0125}$$

$$= A \times 11.0786$$

Hence A = 80,000 / 11.0786 = ₹ 7221

The loan amortisation schedule is shown below:

Loan Amortisation Schedule

Month	*Beginning Amount* (1)	*Monthly Instalment* (2)	*Interest* (3)	*Principal Repayment* (2)–(3) = (4)	*Remaining Balance* (1)–(4) = (5)
1	80,000	7221	1000	6221	73779
2	73,779	7221	922.2	6298.8	67480.2
3	67,480.2	7221	843.5	6377.5	61102.7
4	61102.7	7221	763.8	6457.2	54645.5
5	54645.5	7221	683.1	6537.9	48107.6
6	48107.6	7221	601.3	6619.7	41487.9
7	41487.9	7221	518.6	6702.4	34785.5
8	34785.5	7221	434.8	6786.2	27999.3
9	27999.3	7221	350.0	6871.0	21128.3
10	21128.3	7221	264.1	6956.9	14171.4
11	14171.4	7221	177.1	7043.9	7127.1
12	7127.1	7221	89.1	7131.9	– 4.8@

@ Rounding off error

PROBLEMS

6.1 Future Value Calculate the value 5 years hence of a deposit of ₹ 1,000 made today if the interest rate is (a) 8 percent, (b) 10 percent, (c) 12 percent, and (d) 15 percent.

6.2 Rule of 72 If you deposit ₹ 5,000 today at 12 percent rate of interest in how many years (roughly) will this amount grow to ₹ 1,60,000? Work out this

problem using the *rule of 72*–do not use tables.

6.3 Rule of 69 A finance company offers to give ₹ 8,000 after 12 years in return for ₹ 1,000 deposited today. Using the *rule of 69*, figure out the approximate interest offered.

6.4 Future Value You can save ₹ 2,000 a year for 5 years, and ₹ 3,000 a year for 10 years thereafter. What will these savings cumulate to at the end of 15 years, if the rate of interest is 10 percent?

6.5 Annual Savings Mr. Vinay plans to send his son for higher studies abroad after 10 years. He expects the cost of these studies to be ₹ 1,000,000. How much should he save annually to have a sum of ₹ 1000,000 at the end of 10 years, if the interest rate is 12 percent?

6.6 Interest Rate A finance company advertises that it will pay a lump sum of ₹ 10,000 at the end of 6 years to investors who deposit annually ₹ 1,000. What interest rate is implicit in this offer?

6.7 Interest Rate Someone promises to give you ₹ 5,000 after 10 years in exchange for ₹ 1,000 today. What interest rate is implicit in this offer?

6.8 Present Value Find the present value of ₹ 10,000 receivable after 8 years if the rate of discount is (i) 10 percent, (ii) 12 percent, and (iii) 15 percent.

6.9 Present Value What is the present value of a 5-year annuity of ₹ 2,000 at 10 percent?

6.10 Retirement Plan On retirement, Mr. Jingo is given a choice between two alternatives: (a) an annual pension of ₹ 10,000 as long as he lives, and (b) a lump sum amount of ₹ 50,000. If Mr. Jingo expects to live for 15 years and the interest rate is 15 percent, which option is more attractive?

6.11 Annual Withdrawal Mr. X deposits ₹ 1,00,000 in a bank which pays 10 percent interest. How much can he withdraw annually for a period of 30 years. Assume that at the end of 30 years the amount deposited will whittle down to zero.

6.12 Present Value What is the present value of an income stream which provides ₹ 1,000 at the end of year one, ₹ 2,500 at the end of year two, and ₹ 5,000 during each of the years 3 through 10, if the discount rate is 12 percent?

6.13 Present Value What is the present value of an income stream which provides ₹ 2,000 a year for the first five years and ₹ 3,000 a year forever thereafter, if the discount rate is 10 percent?

Hint: The present value for a perpetual annuity is derived by dividing the constant annual flow by the discount factor.

6.14 Deposit What amount must be deposited today in order to earn an annual income of ₹ 5,000 beginning from the end of 15 years from now? The deposit earns 10 percent per year.

6.15 Interest Rate Suppose someone offers you the following financial contract. If you deposit ₹ 20,000 with him he promises to pay ₹ 4,000 annually for 10 years. What is the interest rate?

6.16 Present Value What is the present value of the following cash flow streams?

Year	1	2	3	4	5	6	7	8	9	10
A	100	200	300	400	500	600	700	800	900	1000
B	1000	900	800	700	600	500	400	300	200	100
C	500	500	500	500	500	500	500	500	500	500

The discount rate is 12 percent.

6.17 Future Value Suppose you deposit ₹ 10,000 with an investment company which pays 16 percent interest with quarterly compounding. How much will this deposit grow to in 5 years?

6.18 Future Value How much would a deposit of ₹ 5,000 at the end of 5 years be, if the interest rate is 12 percent and if the compounding is done quarterly?

6.19 EAR and APR What is the difference between the effective rate of interest and annual percentage rate in the following cases:

Case A: APR 12 percent and the frequency of compounding is six times a year.

Case B: APR is 24 percent and the frequency of compounding is four times a year.

Case C: APR is 24 percent and the frequency of compounding is twelve times a year.

6.20 Investment If the interest rate is 12 percent how much investment is required now to yield an in come of ₹ 12,000 per year from the beginning of the 10^{th} year and continuing thereafter forever?

6.21 Preference You have a choice between ₹ 5,000 now and ₹ 20,000 after 10 years. Which would you choose? What does your preference indicate?

6.22 Value Mr. Raghu deposits ₹ 10,000 in a bank now. The interest rate is 10 percent and compounding is done semi-annually. What will the deposit grow to after 10 years? If the inflation rate is 8 percent per year, what will be the value of the deposit after 10 years in terms of the current rupee?

6.23 Deposit How much should be deposited at the beginning of each year for 10 years in order to provide a sum of ₹ 50,000 at the end of 10 years?

6.24 Deposit A person requires ₹ 20,000 at the beginning of each year from 2035 to 2039. How much should he deposit at the end of each year from 2025 to 2030? The interest rate is 12 percent.

6.25 Present Value What is the present value of ₹ 2,000 receivable annually for 30 years? The first receipt occurs after 10 years and the discount rate is 10 percent.

6.26 Borrowing After five years Mr. Ramesh will receive a pension of ₹ 6000 per month for 15 years. How much can Mr. Ramesh borrow now at 12 percent interest so that the borrowed amount can be paid with 30 percent of the pension amount? The interest will be accumulated till the first pension amount becomes receivable.

6.27 Interest Rate Mr. Prakash buys a motorcycle with a bank loan of ₹ 60,000. An instalment of ₹ 3000 is payable to the bank for each of 24 months towards the repayment of loan with interest. What interest rate does the bank charge?

6.28 **Sinking Fund Deposit** A Ltd. has to retire ₹ 1000 million of debentures each at the end of 8, 9, and 10 years from now. How much should the firm deposit in a sinking fund account annually for 5 years, in order to retire the debenture? The net interest rate earned is 8 percent.

6.29 **Period of Withdrawal** B receives a provident fund amount of ₹ 1,000,000. He deposits it in a bank which pays 10 percent interest. If he withdraws annually ₹ 200,000, how long can he do so?

6.30 **Loan Amortisation** Phoenix Company borrows ₹ 500,000 at an interest rate of 14 percent. The loan is to be repaid in 4 equal annual instalments payable at the end of each of the next 4 years. Prepare the loan amortisation schedule.

6.31 **Maturity Period** You want to borrow ₹ 1,500,000 to buy a flat. You approach a housing company which charges 13 percent interest. You can pay ₹ 200,000 per year toward loan amortisation. What should be the maturity period of the loan?

6.32 **Present Value of Growing Annuity** You are negotiating with the government the right to mine 100,000 tons of iron ore per year for 15 years. The price per ton of iron ore is expected to be ₹ 3,000 at the end of year 1 and increase thereafter at the rate of 6 percent per year. What is the present value of the iron ore that you can mine if the discount rate is 16 percent?

6.33 **Present Value** As a winner of a competition, you can choose one of the following prizes:

a. ₹ 500,000 now

b. ₹ 1,000,000 at the end of 6 years

c. ₹ 60,000 a year forever

d. ₹ 100,000 per year for 10 years

e. ₹ 35,000 next year and rising thereafter by 5 percent per year forever.

If the interest rate is 10 percent, which prize has the highest present value.

6.34 **Present Value of a Decreasing Annuity** Pipe India owns an oil pipeline which will generate ₹ 12 crore of cash income in the coming year. It has a very long life with virtually negligible operating costs. The volume of oil shipped, however, will decline over time and, hence, cash flows will decrease by 3 percent per year. The discount rate is 12 percent.

a. If the pipeline is used forever, what is the present value of its cash flows?

b. If the pipeline is scrapped after 25 years, what is the present value of its cash flows?

6.35 **Present Value of a Decreasing Annuity** An oil well presently produces 50,000 barrels per year. It will last for 15 years more, but the production will fall by 5 percent per year. Oil prices are expected to increase by 3 percent per year. Presently the price of oil is $50 per barrel. What is the present value of the well's production if the discount rate is 10 percent?

6.36 **Present Value of a Decreasing Annuity** An oil well presently produces 80,000 barrels per year. It will last for 20 years more, but the production will fall by 6

percent per year. Oil prices are expected to increase by 4 percent per year. Currently the price of oil is $60 per barrel. What is the present value of the well's production if the discount rate is 12 percent?

6.37 **Future Value** You are considering whether your savings will be enough to meet your retirement needs. You saved ₹ 100,000 last year and you expect your annual savings to increase by 8 percent per year for the next 20 years. If your savings can be invested at 9 percent, how much would you have at the end of the twentieth year? Hint: Future Value Growing Annuity = PVGA $(1 + r)^n$

6.38 **EAR** A bank offers an interest rate of 8 percent on deposits made with it. If the compounding is done on a weekly basis, what is the effective interest rate?

6.39 **Interest Rate** Apna Bank's Kuber deposit plan offers to double your deposit in 7 years under its special daily compounding of interest scheme. What is the interest rate involved?

6.40 **Amortisation Schedule** Monisha has bought an iPhone costing ₹ 100,000 at 9.5 percent p.a, repayable in 5 equated annual instalments. Draw the amortisation schedule for the loan.

6.41 **Waiting Period** James has now joined as a finance manager in an MNC. He can save every year 60 percent of his annual salary of ₹ 10 lakhs (that will be received at the end of the year) and which is expected to increase at the rate of 10 percent every year. He has decided to marry only once his savings crosses ₹ 1 crore mark. If he keeps his savings in a bank that offers 8 percent interest, how many years should he wait to get married?

6.42 **Growing Annuities** Prakash plans to retire after 20 years with a corpus of ₹ 50 million. He receives salary annually and he expects to receive ₹ 3 million at the end of the current year. His salary will increase at the rate of 10 percent per year and he can earn 9 percent on his investment. He plans to save a constant percentage of his salary; what should that percentage be?

6.43 **Discount Interest Loans** You borrow ₹ 100,000 for one year at an interest rate of 15 percent from a lender who deducts the interest in advance from the loan upfront and gives you ₹ 85000. What is the EAR?

6.44 **Break-even Investment Returns** Your investment company offers two different investment plans. Plan A offers a ten-year annuity of ₹ 500,000 whereas plan B offers an annual perpetuity of ₹ 30,0000. Both plans make their first payment a year from today. What discount rate will make you indifferent between the two options?

6.45 **Present Value of Infrequent Annuity** An investment pays ₹ 1,000,000 every four years for 40 years. The first payment will occur after four years. What is the value of this investment if the discount rate is 12 percent and the discounting is continuous?

MINICASE - I

As an investment advisor, you have been approached by a client called Ramesh, who wants some help in investment related matters.

Ramesh is currently 45 years old and has ₹ 600,000 in the bank. He plans to work for 15 more years and retire at the age of 60. Ramesh's present salary is ₹ 400,000 per year. He expects his salary to increase at the rate of 12 percent per year until his retirement.

Ramesh has decided to invest his bank balance and future savings in a portfolio in which stocks and bonds would be equally weighted. For the sake of simplicity, assume that these proportions will be maintained by him throughout. He also believes that bonds would provide a return of 7 percent and stocks a return of 13 percent. You concur with his assessment.

Once Ramesh retires at the age of 60 he would like to withdraw ₹ 500,000 per year from his investments for the following 15 years as he expects to live upto the age of 75 years. He also wants to bequeath ₹ 1,000,000 to his children at the end of his life. How much money would he need 15 years from now?

How much should Ramesh save each year for the next 15 years to be able to meet his investment objectives spelt out above? Assume that the savings will occur at the end of each year.

Suppose Ramesh wants to donate ₹ 200,000 each year in the last three years of his life to a charitable cause. Each donation would he made at the beginning of the year. How much money would he need when he reaches the age of 60 to meet this specific need?

Ramesh recently attended a seminar on human capital where the speaker talked about a person's human capital as the present value of his life time earnings. Ramesh is curious to find out the present value of his lifetime salary. For the sake of simplicity assume that his present salary of ₹ 400,000 will be paid exactly one year from now, and his salary will be paid in annual installments. What is the present value of his life time salary, if the discount rate is 8 percent? Remember that Ramesh expects his salary to increase at the rate of 12 percent per year until his retirement.

In answering the above questions, ignore the tax factor.

MINICASE - II

Sardar Kartar Singh is a resident of Thailand for the past two decades and is the owner of a flourishing business there. He has a son, Satnam, 10 years old and a baby girl Jasleen who will be one year old this day. The family has come to India to celebrate her birthday in Punjab. Also, Kartar's wife has made some grand plans for the future financial security of the family and they intend to use their present visit for placing suitable deposits with their bank in New Delhi as per those plans.

According to the plan, Satnam would be doing his MBA after 10 years. It would be a two year course in a premier private business school in India. For that the all inclusive expenditure at present rates would be ₹ 20 lakhs and ₹ 25 lakhs in the beginning of the first and second year respectively. Jasleen would marry at the end of

her 21st year and for that an amount of ₹ 3 crores would then be needed. Kartar's wife is insistent that her presence would be essential in India in the best interests of both the children-to keep a watchful eye on Satnam during his stint at the business school and most importantly, to have ample time to renew the old network with family and friends for ensuring a very good match for the girl. Funds would have to be tied up for her and children's relocation to India at the end of ten years from now.

Kartar Singh always had great respect for his wife's commonsense and logic (though he was always shy of acknowledging it!). To arrange the funds, he has very recently sold one of his investments, a flat in a prime locality in Bangkok, for a hefty sum. For Satnam's MBA he has decided to open two recurring deposit accounts, maturing on the 10^{th} and 11^{th} years respectively. For Jasleen's marriage he wants to open a cumulative term deposit for 20 years. For family maintenance in India after 10 years, he wants to open another cumulative term deposit for 10 years with the maturity value of which he could immediately purchase an annuity due for the following 10 years. It is expected that after 10 years the family in India would need ₹ 12 lakhs per year without taking inflation into consideration.

To make the calculations on the specific amounts needed he has called you, an upcoming financial consultant. He asks you to make the calculations in such a way that he could easily understand the logic thereof. You understand from him that as all the deposits would be made out of his NRE account with the bank, it would not deduct any tax amount from the interest to be earned.

Specifically you are required to calculate the amounts that need to be deposited now in:

(i) the two recurring deposit accounts, in the beginning of each month.

(ii) a cumulative fixed deposit for meeting the cost of Jasleen's marriage.

(iii) a cumulative fixed deposit with the bank for purchasing the annuity due needed by the family in India after 10 years from an insurance company which is expected to give a return of 10 percent per year.

You set to work with the following data:

For both cumulative fixed deposit and Recurring deposit, nominal interest rate for periods of more than 5 years is 8 percent and compounding is done once in a quarter. Inflation in India after 10 years is expected to be 5 percent for the next ten years. The MBA course expenses are likely to grow at 5 percent per annum.

Show your detailed working.