

Financial Mathematics Assignment - 2

Unit - 3 & 4

Ans 1. (i)

Loan Amount = ₹ 20,000

Monthly installments = ₹ 427.9

Time taken = 5 years

APR \Rightarrow

$$20000 = 427.9 \times a_{\overline{60}|i} @ \frac{i}{12}$$

$$\frac{20000}{427.9} = \frac{1 - v^{60}}{i}$$

$$\frac{\frac{i}{12}}{1} = 0.85834\%$$

$$\therefore i = 10.8\%$$

$$\text{flat rate} = \frac{\text{Total repaid} - \text{Original Amount}}{\text{Term of loan} \times \text{Original Amount}}$$

$$= \frac{(427.9 \times 60) - 20000}{(20000) 5}$$

$$= 5.674\%$$

$$\text{APR} = 2 \text{ times flat rate}$$

$$= 2 \times 5.674\%$$

$$= 11.248\%$$

(ii) NPV after 1 year

$$= 427.9 \times a_{\overline{7}|}^{(12)} @ i = 10.8\%$$

$$= ₹ 16775.83$$

Term of new loan =

$$16775.83 = 274.49 \times a_{\overline{n}|}^{(12)} @ \frac{i}{12} = 0.8834$$

$$\frac{16775.83}{274.49} = \frac{1 - (1.008543)^{-n}}{0.0085843}$$

$$\therefore n = 7.2511 \text{ years}$$

(iii) Interest of reconstructed loan

$$= (427.9 \times 12) + (274.49 \times 12 \times 7.25) - 20000$$

$$= 23880.63 + 16775.83 - 20000$$

$$= ₹ 9015.43$$

$$\text{Extra interest paid} = 9015.43 - 5674$$

$$= ₹ 3341.43$$

Ans 2. d

a) Discounted Payback Period

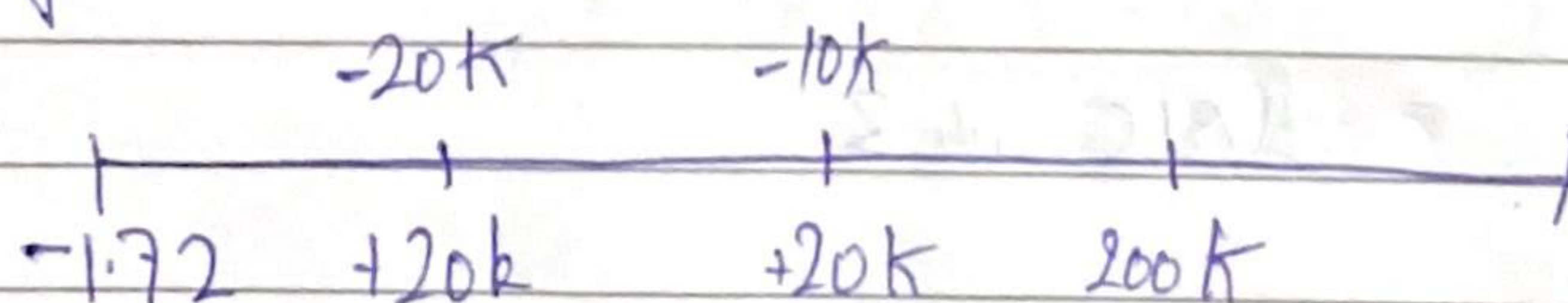
It is the time at which NPV turns from positive to negative, the initial outlay has been recovered taking interest into account.

b) Payback Period

It is the time when cumulative receipts are greater than the initial expenditure without considering interest rate.

(ii) NPV shows the difference between the present value of inflows & present value of outflows, hence showing us the feasibility of the project, the amount of return expected to be generated using pessimistic risk discount rate whereas DPP & PP just show us how much time will it take to recover the investment.

(iii) Project A



$$\begin{aligned}
 NPV &= -170k + 10k v^2 + 200k v^3 \quad @ 6\% \\
 &= -170k \\
 &= (-170 + 8.896 + 169.92385)k \\
 &= £ 6822.85
 \end{aligned}$$

$$IRR = PV = 0 = -170 + 10r^2 + 200r^3$$

$$IRR = 7.423\%$$

Project B

$$NPV = -200k + 149.977 @ 6\% + 200k r^6$$

$$= -200 + 14(4.9173) + 200(1.06)^6$$

$$= 9,834.65$$

$$IRR \Rightarrow$$

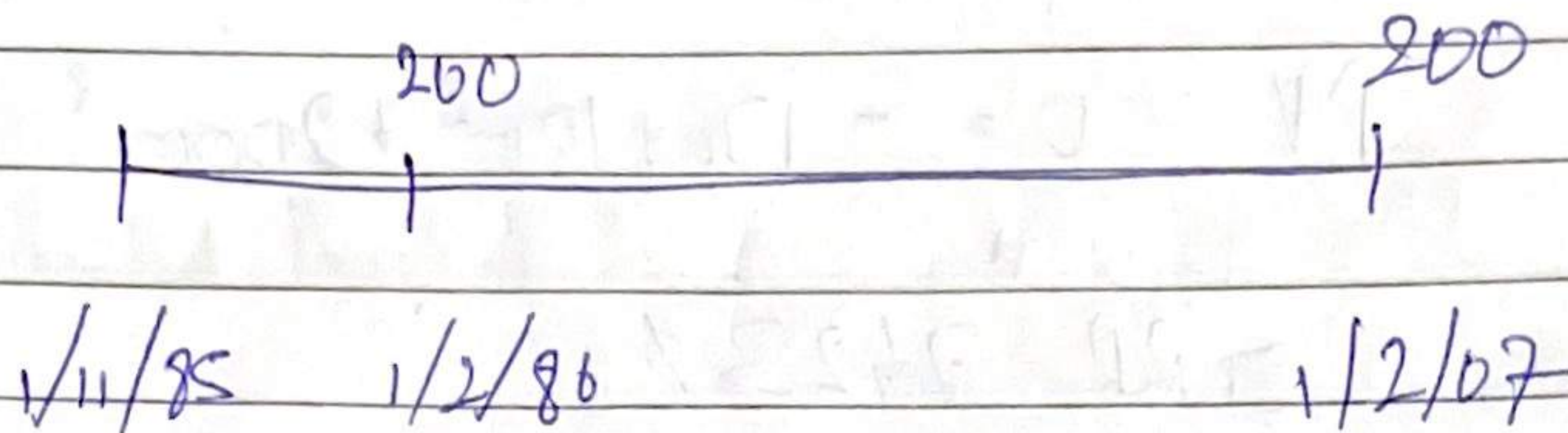
$$0 = -200 + 149.977 + 200r^6$$

$$IRR = 7\%$$

Each Both the projects would be profitable
if the rate of return is less than
IRR

For Project A less than 7.4%
For Project B less than 7%

Ans 3.

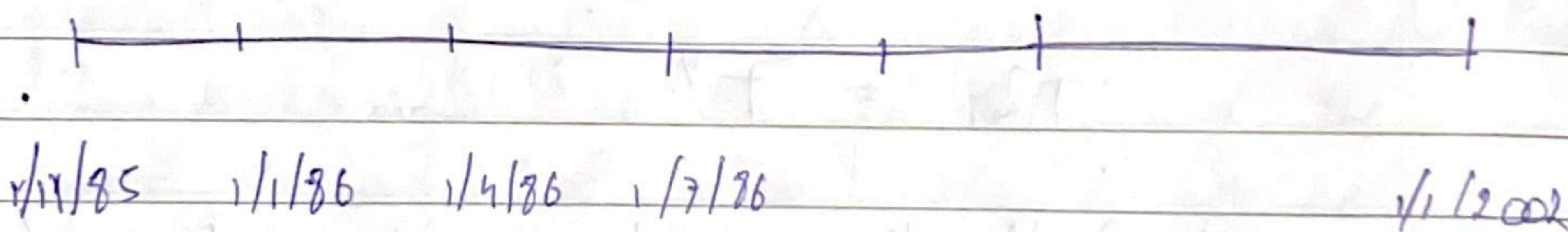


\therefore Annuity $1 \Rightarrow$

$$= 200 \times v^{0.25} \times a_{\overline{27}|}$$

$$= 200 \times 11.01676 \times 0.980944$$

$$= 2161.36$$



Annuity 2 \Rightarrow

$$= 320 \times (1+i)^{1/12} \times a_{\overline{16.25}|}$$

$$= 2957.872$$

$$\text{Annuity 3} = 180 a_{\overline{12}|} @ 8\%$$

$$= 1786.665$$

$$\text{Sum of 3 Annuities} = 1780.67 + 2957.87 + 2161.36 \\ = 6899.9$$

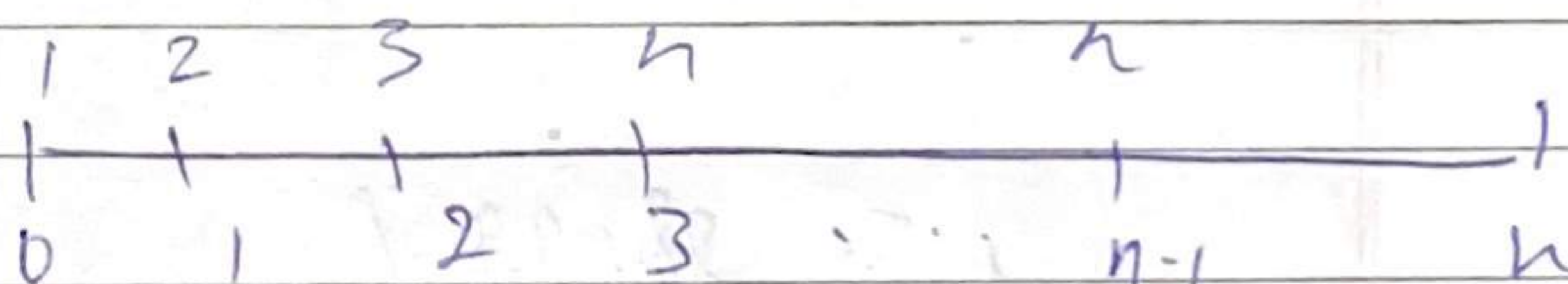
Revised Annuity

$$6899.9 = A \times (1+i)^{14} \times a_{\overline{21}|i}$$

$$A = 656.56$$

Ans 4.

$$(\overline{I\ddot{a}})_{\overline{n}|i} \Rightarrow$$



$$PV = 1 + 2v + 3v^2 + 4v^3 + \dots + nv^{n-1}$$

$$= (1+i)(\overline{Ia})_{\overline{n}|i}$$

$$= (1+i) \left(\frac{\ddot{a}_{\overline{n}|i} - nv^n}{i} \right)$$

$$= \frac{\ddot{a}_{\overline{n}|i} - nv^n}{i}$$

$$= \frac{\ddot{a}_{\overline{n}|i} - nv^n}{d}$$

Ans.

(i) TWRP of property fund

$$(1+i) = \frac{16.4}{12.4}$$

$$i = 1.3225806 - 1$$

$$= 32.25806\%$$

TWRP of Equity fund

$$(1+i) = \frac{15.5}{12.1}$$

$$i = 28.099\%$$

(ii) a) Assuming bought 10 units each quarter

$$\Rightarrow 124(1+i) + 131(1+i)^{0.75} + 148(1+i)^{1.5} + 158(1+i)^{2.25}$$

$$\Rightarrow i = 29.32\%$$

b) Assuming bought Rs 100 worth

$$\Rightarrow 100 \ddot{a}_{\overline{4}|i} = 100 \left[\frac{16.4}{12.4} + \frac{16.4}{13.1} + \frac{16.4}{14.8} + \frac{16.4}{15.8} \right]$$

$$i = 29.75\%$$

(iii) Assuming bought 10 units of equity fund

$$121(1+i) + 92(1+i)^{0.75} + 103(1+i)^{0.5} + 131(1+i)^{0.25}$$

$$= 421.55$$

$$i = 67.31\%$$

Assuming if they put Rs 100 / quarter

$$400 \cdot i^{(4)} = 100 \times 15.5 \left(\frac{1}{12.1} + \frac{1}{9.2} + \frac{1}{10.3} + \frac{1}{13.1} \right)$$

$$i = 70.88\%$$

Ans 6.

i) $160,000 = X \cdot a_{\overline{10}|8\%}$

$$\therefore X = \frac{160000}{6.7101}$$

$$= 23,844.65$$

(ii) Loan of after 4 payment

$$= 23,844.65 \cdot a_{\overline{4}|8\%}$$

$$= 110,231.432$$

Annual repayments

$$110,231.432 = Y \cdot a_{\overline{10}|10\%}$$

$$\therefore Y = 25,305.722$$

ii) Loan after c/s after 7th payments

$$\Rightarrow 25309.722 \times 97 @ 10\%$$

$$= 62942.747$$

\therefore

$$62942.747 = x \times 97 @ 9\%$$

$$x = 24865.779$$

Total Repayment

$$\Rightarrow (4 \times 23844.65) + (3 \times 25309.722) + (3 \times 24865.779)$$

$$= 2,45,905.907$$

$$\therefore 160000(1+i)^0 = 2,45,905.907$$

$$i = 4.3914\%$$

Ans 7. i) Government securities provide fixed yield regardless market conditions whereas in property, income depends on market conditions and there could be periods with no income.

Govt securities are also safer unlike property as proven in 2008 crash.

ii) a) A loan like by tender would introduce involve the government asking investors to submit prices at which they will buy fixed securities from government.

b) Advantage to government is that it can choose the highest price to offer & sell all securities.

Disadvantages could be that the securities might not be by a wide variety of investors & be concentrated.

Advantage to investors is they can put in their ideal price.

iii) Shares have uncertain income, as dividends are at discretion of directors.

Index linked bonds are the absolute income to be received isn't know & there could be deflation. Savings interest as interest rates change frequently.

Ans 8:

i) NPV

Present value of outlay
- Present value of inflow

$$= -2.7 \text{ or } -2.06937 @ i = 10\% + 0.1v^3 +$$

$$0.25v + 0.2v^2 + 0.1v^3$$

$$i = 9.3\%$$

ii)

$$0.1v^3 + 0.85v - 2.7 - 0.206937 @ i = 10\%$$

$$= 4.19 - 3.18$$

$$= 1.0089$$

As NPV is positive Project can be considered for investment.

Ans 9. i) TWR of fund.

$$(1+i)^3 = \frac{33}{30.5} \times \frac{38.65}{39} \times \frac{45.6}{41.05} \times \frac{47}{45.6-2.5}$$

$$i = 7.095\%$$

NWR

$$47 = 30.5(1+i)^3 + 6(1+i)^{2.25} + 4.5(1+i)^{1.5} - 2.5(1+i)^{0.5}$$

$$i = 7.206\%$$

iii) TWR takes the time of income and outflow & fund into consideration and isn't affected by quantity of money that comes or goes out or grows unlike in NWR which is affected by such activities.

Ans 10.

$$\text{Loan} = 180k [a_{15} @ 12\%] + 20k [Ia_{15}]$$

$$= 180 (6.8109) + 20 (90.731)$$

$$= 1225.962 + 1814.62$$

$$= 2040.582$$

$$\text{Total cost} = \text{loan} + \text{self}$$

$$= 80\% \text{ of TC} + 20\% \text{ of TC}$$

$$2040.582 = \frac{80}{100} \times \text{TC}$$

$$\text{TC} = 25,50,727.5$$

Loan ops after $t=8$

$$340000 a_{77} @ 12\% + 20000 (Ia_{77})$$

$$= 15,51,692 + 324160$$

$$= 18,75,852$$

Term	loan at start	Repaid	Int	Loan ops	loan ops
4	1875852	360000	2250224	1348917.76	↓
10	1740954	380000	20814.5	171015.44	
				1740954	
				1569869	

Ans 11. i) TWR

$$(1+i)^2 = \frac{500}{460} \times \frac{550}{540} \times \frac{600}{540}$$

$$(1.2)^2 = 1.44$$

$$x = (1.44 \times 550) / (1.08975 \times 1.1111)$$

$$x = 655.78$$

ii) NWR

$$460(1+i)^2 + 40(1+i)^{1.75} - 50(1+i) = 655.78$$

$$i = 19.85\%$$

iii) Effective interest rate of 205

$$460(1+i) + 40(1+i)^{0.75} = 600$$

$$i = 20.44\%$$

Effective interest rate of 2016

$$(1+i) = \frac{655.78}{550} = 1.1923$$

∴ LWR

$$(1+i)^2 = 1.1923 \times 1.2044$$

$$i = 14.83\%$$

Ans 12. i) PPP is when NPV turns positive first time taking interest into account.

ii) a) $-800(1+i)^t - 50(1+i)^{t+1} + 100 \bar{A}_{\overline{t-2}|} = 0$

$$t = 17.767$$

using trial & error

b) Accumulated profit after 22 years

$$\therefore 100 \bar{A}_{\overline{4.233}|} @ 6\% = 480$$

$$\therefore Rs\ 480,000$$

iii) $100 \bar{A}_{\overline{4}|} = 102.971$

$$-800(1+i)^t - 50(1+i)^{t+1} + 102.971 \bar{A}_{\overline{t-2}|} @ 7\%$$

By trial & error

$$t = 18 \text{ years}$$

$$-800(1+i)^{18} - 50(1+i)^{19} + 102.971 \bar{A}_{\overline{16}|} = 9.7714$$

Hence AV_{22}

$$\therefore F\ 462.790$$

Ans 13

i) $\times a_{\overline{25}|}^{(12)} = 9880 @ 7\%$

$$V = 821.76$$

$$\times 112 = 68.48$$

ii) Loan off c/s after 10/03/29

$$821.76 \times a_{\overline{11\frac{1}{3}}|}^{(12)}$$

$$= 648600$$

iii) Loan c/s on 10 sept 2016

$$821.76 \times a_{\overline{13\frac{5}{6}}|}^{(12)}$$

Loan c/s on 10 oct 2016

$$821.76 \times a_{\overline{13.75}|}^{(12)}$$

$$\therefore 821.76 \left[a_{\overline{13\frac{5}{6}}|}^{(12)} - a_{\overline{13.75}|}^{(12)} \right]$$

$$= 26.86$$

iv) i) Capital repayment on 12th month

$$\Rightarrow 821.76 \left[a_{\overline{7\frac{1}{2}}|}^{(12)} - a_{\overline{6\frac{1}{3}}|}^{(12)} \right]$$

$$\Rightarrow 516.20$$

ii) Interest -

$$\Rightarrow 821.76 - 516.20$$

$$\Rightarrow 305.50$$