(a)

FM - Assignment → '2'

Ques ① Loan amount = 20,000.

Monthly Payments (arrears) = 427.90.

Time = 5 years

$$20000 = (12)(427.9)a_{\overline{5}|}^{(12)} \quad @ \ i$$

$$a_{\overline{5}|}^{(12)} = 3.894991042$$

$$\frac{1-v^5}{i^{(12)}} = 3.89499.$$

$$\frac{1-(1+i)^{-5}}{12\left((1+i)^{1/12}-1\right)} - 3.89 = 0$$

if $i = 10\%$. LHS = 3.96254

$i = 11\%$. LHS = 3.82812.

∴ By interpolating:

$i = 10.8\%$

So, APR = 10.8%

(ii) $PV_1 = 427.9 \times 12\, a_{\overline{4}|}^{(12)}$ at $i = 10.8\%$

$= (427.9)(\cancel{12}) \dfrac{1-(1.108)^{-4}}{(\cancel{12})[0.008583007)}$

$$\boxed{PV_1 = 16775.97728}$$

$16775.97728 = (12)(274.49)\, a_{\overline{T}|}^{(12)}$ @ 10.8%

$\dfrac{1-v^{-T}}{12(0.008583007)} = 5.09307$

$(1.108)^{-T} = 0.475433238$

$\boxed{T = 7.2499}$ years.

(iii) Interest paid in Ist loan : ~~5674~~.3763.22

Int. Paid in IInd $= 7104.3233.$

Interest Paid more $=$ ~~\$~~ ₹ ~~1430.323~~ 3341.43.

Ans (2)

(b) $\boxed{\text{Payback Period}}$: It is the no. of years necessary to recover funds invested in project without considering the interest at all both on the borrowing & ~~lend~~ investing.

a) i) Discounted Payback Period → It is the number of years after which the cumulative discounted cashflow covers the initial investment.

(ii) Unlike the NPV, neither the DPP nor the PP gives any indication of the profitable a project is, as they ignore cash flows after the accumulated value of zero is reached.

There may not be one unique time when the balance in the investor's account changes from -ve to +ve. However the NPV can always be calculated..

The PP gives misleading results, as it does not take into account time value of money. Hence the NPV is a superior measure as compared to DPP or PP.

(iii) IRR of Project A

PV of outlay : $-170 - 20v - 10v^2$.

PV of inlay : $20v + 20v^2 + 200v^3$.

So, NPV ⇒ $20v + 20v^2 + 200v^3 = 0$.

$$-170 - \cancel{20v} - 10v^2 + \cancel{20v} + 20v^2 + 200v^3$$

$$-170 + 10v^2 + 200v^3 = 0$$

$$-170 + 10(1+i)^{-2} + 200(1+i)^{-3} = 0.$$

$$170 = 10(1+i)^{-2} + 200(1+i)^{-3}$$

at $i = 0.07$ $\quad$ LHS $= 171.44$

$i = 0.08$ $\quad$ LHS $= 167.33$

$\frac{6}{0.06}$

0.94

hence by interpolating $i = 7.4\%$.

$1+i = \frac{1}{1-d}$

$1+i = (1-d)^{-1}$

Project → B

Project outlay: -200.

Project inlay: $14a_{\overline{6}|} + 200v^6$.

So, NPV:

$$200 = 14\left(\frac{1-v^6}{i}\right) + 200v^6$$

$$200 = 14\left(\frac{1-(1+i)^{-6}}{i}\right) + 200(1+i)^{-6}$$

At $i = 0.07$ $\quad$ LHS $= 200$

$\cancel{i}$ $\quad$ $\cancel{LHS}$

by interpolating: $\boxed{i = 7\%}$

$v = \frac{1}{1-i}(1-i)^{-1}$

$d = \frac{i}{1-i}$

(ii) Project A

$$NPV = 20v + 20v^2 + 200v^3 - 170 - 40v - 10v^2$$

$d = 6\%$ $\Rightarrow$ $20(1-d)^2 + 200(1-d)^3 - 170 - 10(1-d)^2$

$\Rightarrow 4.9528$

Project B.

$$NPV = -200 + 14a_{\overline{6}|} + 200v^6 \quad @ \quad d = 6\%.$$

$= 5.995851$

(c) So, Project A would be profitable if the borrowing rate is less than 7.4% & for Project A less than 7%.

other factors include e

→ Project A doesn't provide any net income during first year.

→ The lower IRR for Project 'B' applies for a longer period.

→ The rates of interest available in years 4 to 6 (i.e after Project A has finished) will affect the comparison b/w the accumulated profits at the end of the year 6 (i.e when Project B finishes.).

PV ~~of~~ annuity $-I_{22}$

Ques (3) (i) $v^{\frac{3}{12}}\, 200\, \ddot{a}_{\overline{22}|}$

$\Rightarrow (1.08)^{-3/12} \times 200 \times a_{\overline{22}|} \times \frac{i}{d}$

$\Rightarrow (1.08)^{-3/12} (200) (10.2007) \frac{(0.08)}{0.074074}$

$\Rightarrow$ ~~2246.156952~~ 2161.365534.

PV of annuity 2

$$320\, \ddot{a}^{(4)}_{\overline{16.25|}} \times v^{\frac{1}{6}} \Rightarrow (320)\, \frac{1-v^{16.25}}{i} \times \frac{i}{d^{(4)}}$$

$$= 320\, \frac{1-(1.08)^{-16.25}}{0.08} \times 1.049519.$$

$$= 2996.04887$$

PV of annuity (3)

$$15\, \ddot{a}_{\overline{226|}} \quad @\ d^{(12)}/12.$$

$$@\ \frac{d^{(12)}}{12} = 0.0063929917$$

$$15\, \frac{\left(1-1.08^{-\frac{226}{12}}\right)}{0.0063929917} \Rightarrow \boxed{1795.651419}$$

So, total of three annuities $= \boxed{6953.065823}$

Revised annuity :

$$6953.065823 = X\, \ddot{a}^{(2)}_{\overline{21.5|}} \quad @\ d^{(2)} \quad i = 0.08.$$

$$6953.065823 = X \left(\frac{1-1.08^{-21.5}}{0.08}\right) \times (1.059615)$$

$$\boxed{X = 649.0135657}$$

Ques (4) $I\ddot{a}_{\overline{n}|}$ $i>0$

- To Prove: $I\ddot{a}_{\overline{n}|} = \dfrac{\ddot{a}_{\overline{n}|} - nv^n}{d}$

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

Multiplying $(1-d)$ on both sides.

② — $(1-d)\,PV = \cancel{v} v^0 + 2v^2 + \dots (n-1)v^{n-1} + nv^n$

① − ②

$d\,(PV) = (1 + v + v^2 + \dots v^{n-1}) - nv^n$

We know: $1 + v + v^2 + \dots = \ddot{a}_{\overline{n}|}$

So, $\boxed{PV = \dfrac{\ddot{a}_{\overline{n}|} - nv^n}{d}}$ hence proved.

Ques (5) (1) TWRR for Property fund.

$(1+i) = \dfrac{13.1}{12.4} \times \dfrac{14.8}{13.1} \times \dfrac{15.8}{14.8} \times \dfrac{16.4}{15.8}$

$\Rightarrow \dfrac{16.4}{12.4} =$

$\boxed{i = 32.2580645\%}$

TWRR for equity fund

$(1+i) = \dfrac{9.2}{12.1} \times \dfrac{10.3}{9.2} \times \dfrac{13.1}{10.3} \times \dfrac{15.8}{13.1} \Rightarrow$ $\boxed{i = 28.0991736\%}$

(ii) (a) ~~Assuming that inves~~ Project → Property fund..

$$12.4(1+i) + 13.1(1+i)^{3/4} + 14.8(1+i)^{1/2} + 15.8(1+i)^{1/4} = 4\times16.4$$

where $i = 0.2932$ or 29.32%.

Project → equity fund :

$$12.1(1+i) + 9.2(1+i)^{3/4} + 10.3(1+i)^{1/2} + 13.1(1+i)^{1/4} = 4\times15.5$$

$$\boxed{i = 67.31\%}$$

Ques (6) (a) $160\,000 = X\, a_{\overline{10}|}$ @ 8%

$$\boxed{X = 23844.65209}$$

(b) So, loan o/s at $t=4$.

$PV_4 = 23844.65209\, a_{\overline{6}|}$ @ 8%.

$$\boxed{PV_4 = 110231.4422}$$

So, let the revised Payment be X'.

$110231.4422 = X'\, a_{\overline{6}|}$ @ 10%

$$\boxed{X' = 25309.72428}$$

(iv) So, $PV_7 = 25309.72428\, a_{\overline{3}|}$ @ 10%

$PV_7 = 62942.75331$

So, let 'R' be the final amount

So, $62942.75331 = R\, a_{\overline{3}|}$ @ 9%

$R = 24865.78174$

Ques (8)

(i) The Present value of outlay is : $1+i = v^{-1}$

$2.7 + 0.2\, a_{\overline{3}|}$ @ i

Expected present value of income is :

$0.1v^3 + \bar{a}_{\overline{10}|}\,(0.25v + 0.2v^2 + 0.1v^3)$ @ i

Equating the present value of outlay to that of PV of inlay.

$2.7 + 0.2\, a_{\overline{3}|} = 0.1v^3 + \bar{a}_{\overline{10}|}\,(0.25v + 0.2v^2 + 0.1v^3)$ @ i

$2.7 + 0.2\left(\frac{1-v^3}{v^{-1}-1}\right) = 0.1v^3 + \frac{1-v^{10}}{-\ln(v)}\,(0.25v + 0.2v^2 + 0.1v^3)$

So,

$\boxed{i = 9.3\%}$

(ii) Based on info :

$0.1v^3 + 0.85\,\bar{a}_{\overline{10}|}\,v^3$ @ $i = 10\%$

$0.1v^3 + 0.85\,\bar{a}_{\overline{10}|}\,v^3 - 2.7 - 0.2\,a_{\overline{3}|}$

$0.1v^3 + 0.85\,\bar{a}_{\overline{10}|}\,v^3 - 2.7 - 0.2 \times 2.48685$ 36%

$0.1(0.7513) + 0.85 \times 0.7513 \times 6.4469$

$4.19 - 3.19 \Rightarrow \boxed{1.0089}$

Since NPV is +ve hence it's worth to invest in project!

Ques ⑧ TWRR

$(1+i)^3 = \frac{33}{30.5} \times \frac{38.5}{33+6} \times \frac{41.05-4.5}{38.5} \times \frac{45}{41.05} \times \frac{45.6}{45} \times \frac{47}{45.6}$

$(1+i)^3 = 1.228313$

$1+i = 1.070951$

So, $\boxed{i = 7.0951\%}$

MWRR

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

At $i = 7\%$, LHS $= 46.74$

$i = 7.5\%$, LHS $= 47.37$

By interpolation : $\boxed{i = 7.206\%}$

$\Rightarrow$ $\boxed{MWRR = 7.206\%}$ soln.

(ii) Linked rate of return.

Year 2011 $\rightarrow$ equation of value

$30.5(1+i) + 6(1+i)^{0.25} = 38.50$.

$\boxed{i = 6.266\%}$ —— (i)

Year 2012 $\rightarrow$ $38.5(1+i) + 4.5(1+i)^{0.5} = 45$

$\boxed{i = 4.92\%}$ —— (ii)

Year 2013 $\rightarrow$ $45(1+i) - 2.5(1+i)^{0.5} = 47$

$\boxed{i = 10.276\%}$ —— (iii)

Linked Rate of return $\therefore \rightarrow$ $(1+i)^3 = (1+0.06266)^* (1+0.0492)^* (1+.10276)$

$\boxed{i = 7.13\%}$ $\leftarrow$ soln.

(iii) TWRR eliminates the effect of cashflow amount & timing ; and ∴ gives a fairer basis for assessing the investment performance for the fund. MWRR is sensitive to amount & timing of the net cashflows.

Ques10) (i) Let the loan amount be L

$L = 180000\, a_{\overline{15}|} + 20000\, (Ia)_{\overline{15}|}$ @ 12%

Amount of loan from bank = Rs 20,40,588.

Total cost of house = 2040588 / 0.8

$= \boxed{\text{Rs } 25{,}50{,}735}$

(ii) Loan O/s at begining of 9th year,

$L = (180000v + 180000v^2 + \ldots + 180000v^7) + (9 \times 20000v + 10 \times 20000v^2 \ldots$

$L(9) = 340000\, a_{\overline{7}|} + 20000\, (Ia)_{\overline{7}|}$ @ 12%

$L(9) = 1875850.33$.

Loan Schedule :

Year	Loan O/s	Loan Installment	Interest	Cap. Repayment
9	1875850.33	3,60,000	2,25,102.04	1,34,897.9
10	1740952.37	3,80,000	2,08,914.28	1,71,085.72
11	1569866.65			

E (iii) Let the new installment be Rs 'P'.

$1569866.65 = P \, a_{\overline{5}|}$

$P = 4,14,126.87$

→ Extra Payment made by Mr Sam if loan continued with bank Ist :

Total installment less o/s at end of 10^{th} year :→

⇒ 6,30,133.35

→ Extra Payment made by Mr Sam if loan transferred to second bank :

Total installments + 1% processing fees − loan o/s at end of 10^{th} year

⇒ 5,16,466.35.

Sol^n

⇒ Clearly it's advicable to Mr Sam to transfer the loan to bank II

Ques (ii) TWRR: $(1+i)^2 = \frac{500}{460} \times \frac{550-50}{500+40} \times \frac{600}{550} \times \frac{x}{600}$

$0.2 = \frac{500}{460} \times \frac{500}{540} \times \frac{x}{550} \Rightarrow \boxed{x = 786.9312}$

(iii) MWRR: $460(1+i)^2 + 40(1+i)^{20/12} - 50(1+i) = 786.9312$

$\boxed{i = 30.909\%}$

Q12 : (i) Discounted Payback Period = is the no. of years after which the cumulative discounted cash inflows covers the initial investment

(ii) a) DPP : $-800(1+i)^t - 50(1+i)^{t-1} + 100\, s_{\overline{t-2|}}$ @ 7% = 0

$t = 17$, NPV = -75

$t = 18$ NPV = 22.85

by interpolation $\boxed{t = 17.767}$

b) The accumulated profit after 22 years =>

$100\, s_{\overline{4.2331|}}$ @ 6% = 480.

$\boxed{\text{Accumulated Profit} = \text{Rs } 480{,}000}$

(iii) The business man may accumulate his rental income @ 6% each year :

$-800(1+i)^t - 50(1+i)^{t-1} + 102.971\, s_{\overline{t-2|}}$ @ 7%.

So, $\boxed{t = 18 \text{ years}}$

Now : $-800(1+i)^{18} - 50(1+i)^{17} + 102.971\, s_{\overline{16|}}$ at 7%.

=> 9.7714.

Hence accumulated profit after 22 years is

$9.7714(1+i)^4 + 10\, s_{\overline{4|}}$ @ 6%.

=> $\boxed{462.79}$ ← accumulated amount after 22 years.

Q13:

(i) $980000 = 12 X a_{\overline{25}|}^{(12)}$

so, $\boxed{X = 6848}$

hence monthly payments $= Rs\ 6848.$] ← sol^n.

(ii) The loan o/s immediately after the repayment on 10th March 2029

$X a_{\overline{34/3}|}^{(12)} = 648,600$ @ 7%

(iii) loan o/s just after the repayment on 10th Sept. 2026

$\Rightarrow X a_{\overline{83/6}|}^{(12)}$ @ 7%.

loan o/s just after the repayment on 10th oct 2026,

$X a_{\overline{13.75}|}^{(12)}$ @ 7%

→ capital repayed on 10th oct, 2026.

$X \left[a_{\overline{83/6}|}^{(12)} - a_{\overline{13.75}|}^{(12)} \right]$ @ 7%

$\Rightarrow 26.86.$

(iv) (i) capital repayment continued in these 12 installments is

$X \left[a_{\overline{22/3}|}^{(12)} - a_{\overline{19/3}|}^{(12)} \right]$ @ 7%

$\Rightarrow 516.2$

(ii) Total interest in these 12 instalments is

~~[illegible]~~ $\boxed{305.56}$ sol^n.