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A1) Find the regular expression over $\Sigma = \{a, b\}$, corresponding to :-

i) The set of all strings containing exactly two a's,

⇒ $L_1 = \{aa, aab, baa, baab, abab \ldots\}$

$R = aa + aab + baa + baab + abab + \ldots$

$\therefore R = b^* \cdot ab^* \cdot ab^*$

ii) The set of all strings containing at least two a's :-

⇒ $L_1 = \{aa, aab, aaab, baaab, babab, \ldots\}$

$R = aa + aab + aaab + baaab + babab + \ldots$

$\therefore R = (a+b)^* a(a+b)^* a(a+b)^*$

iv) The set of all strings containing the substring aa.

⇒ $L_1 = \{baab, abaaba, babaabab, \ldots\}$

$R = baab + abaaba + babaabab + \ldots$

$\therefore R = (a+b)^* aa(a+b)^*$

iii) The set of all strings containing at most two a's

⇒ $L_1 = \{\epsilon, a, aa, ab, abab, baba, \ldots\}$

$R = \epsilon + a + aa + ab + abab + baba + \ldots$

$\therefore R = (b^* ab^* ab^* + b^* ab^*)$

A2) Find the regular expression representing the set of all strings of the form :-

i) $a^m b^n c^p \ (m,n,p >= 1)$

⇒ $L_1 = \{aabbcc, abc, aaabbbccc, \ldots\}$

$R = aabbcc + abc + aaabbbccc + \ldots$

$\therefore R = aa^* bb^* cc^*$

ii) $a^m b^{2n} c^{3p} \ (m,n,p >= 1)$

⇒ $L_1 = \{abbccc, aabbbbcccccc, \ldots\}$

$R = abbccc + aabbbbcccccccc + \ldots$

$\therefore R = aa^* (bb)(bb)^* ccc(ccc)^*$

iii) $a^n b a^{2m} b^2 \ (m >= 0, n >= 1)$

⇒ $L_1 = \{abbb, aabaabb, aaabaaaabb, \ldots\}$

$R = abbb + aabaabb + aaabaaaabb + \ldots$

$\therefore R = aa^* b (aa)^* bb.$