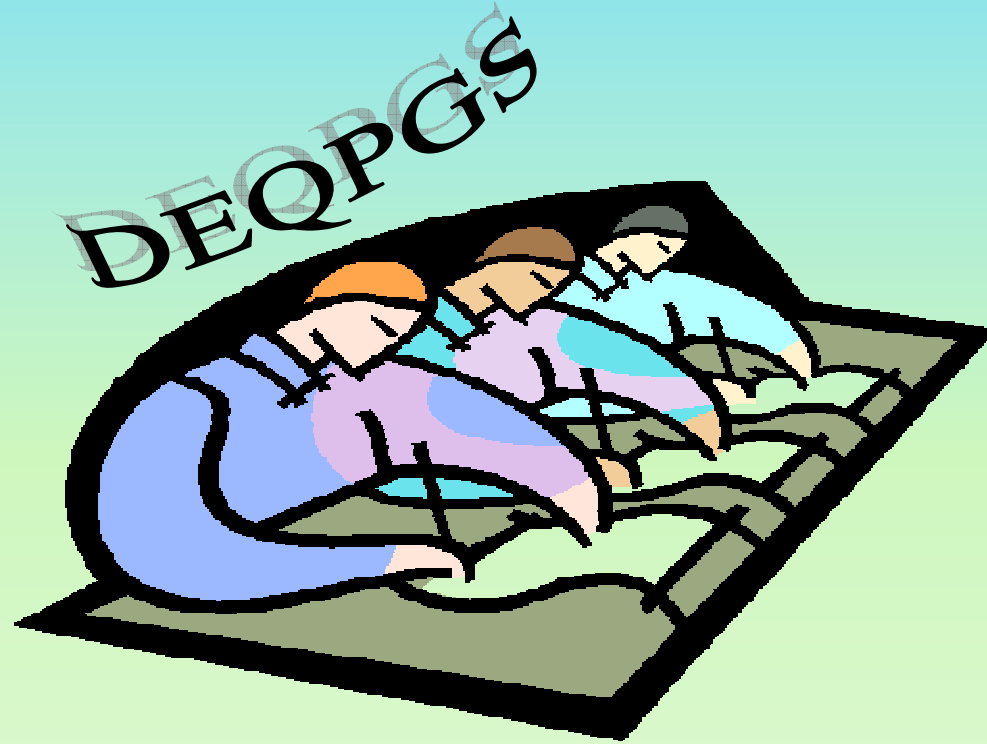


Dynamic Examination Question Paper Generation System (DEQPGS)



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Motivation

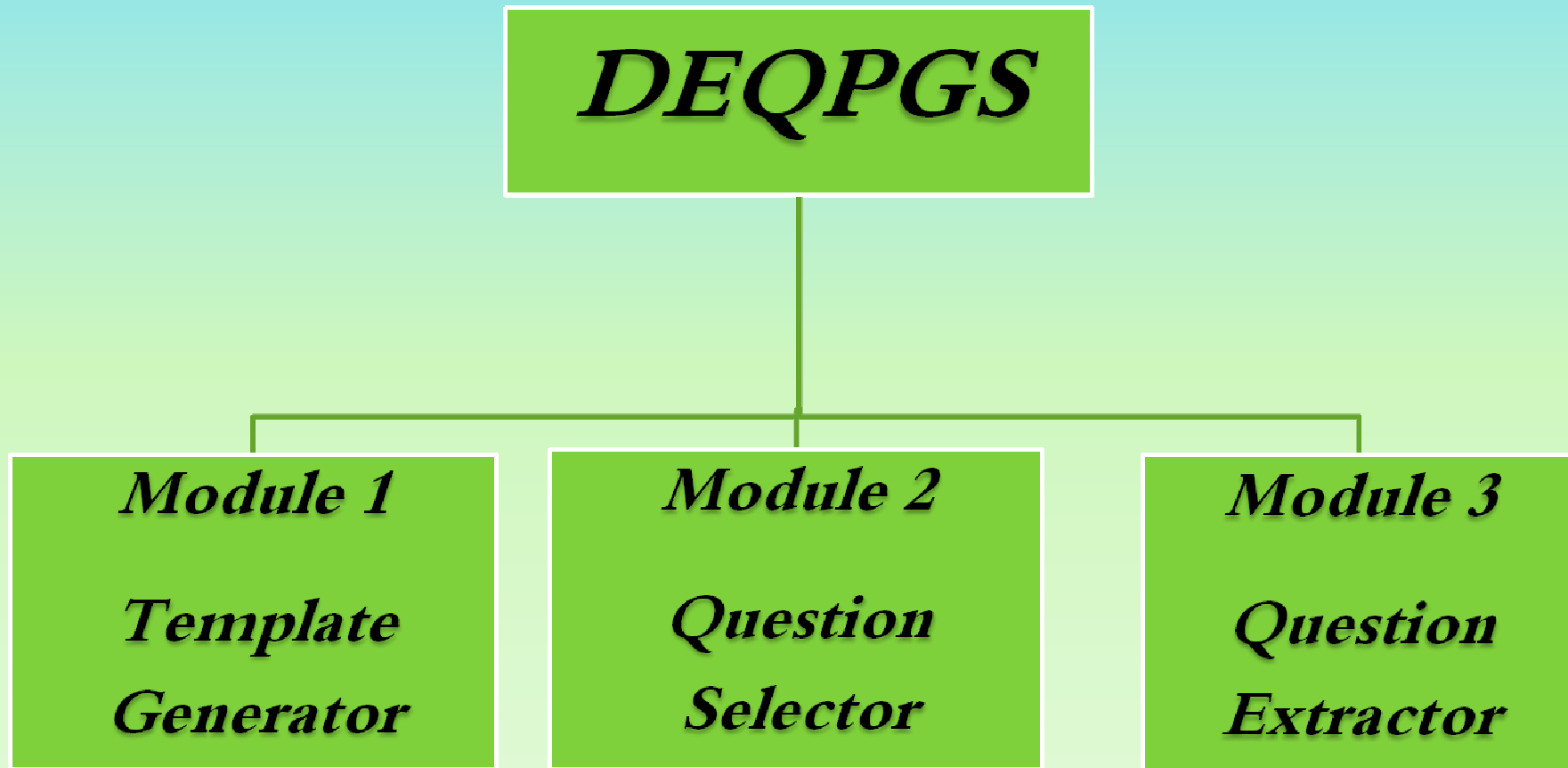
- ❖ **Generate an examination Question Paper considering different levels of Educational Taxonomy(Bloom's) and module wise Syllabus content of the subject.**

Benefits

- ❖ **Resolves the difficulty in setting multiple sets of Question Papers for each examination.**
- ❖ **Qualitative Questions of different difficulty levels of a module stored in the Question Bank can be shared.**
- ❖ **Efficient marks allocation in a Question Paper for each module considering different levels of Educational Taxonomy.**

DEQPGS

Main Modules of DEQPGS



Module 1: Template Generator

4

A Question Paper Template -

- ❖ provides a framework for the structure of the question paper.
- ❖ defines the scope of the paper with respect to syllabus content and type of skills being tested by the examination.
- ❖ can lead to the generation of multiple sets of question papers depending on the type of questions and the actual content of questions selected by the Question Selector.

Table 1. Sample Question Paper Template

Level/ Modules	knowledge	understanding	application	analysis	synthesis	evaluation	Module weight
module 1	5	1	5	3	0	1	15
module 2	8	6	0	1	0	0	15
module 3	2	6	0	3	1	0	12
module 4	4	3	0	1	1	3	12
module 5	2	3	1	0	3	1	10
module 6	5	1	3	1	0	0	10
module 7	4	5	1	0	0	0	10
module 8	5	3	0	0	0	0	8
module 9	4	2	0	0	0	0	6
module 10	1	0	0	1	0	0	2
Level weight	40	30	10	10	5	5	100

Mathematical Model of Template

5

Table 2. Mathematical Model of Template

Level/ Modules	knowledge	understanding	application	analysis	synthesis	evaluation	module variables	module weight
module 1	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	m_1	$m_1\%$
module 2	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	m_2	$m_2\%$
module 3	x_3	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	m_3	$m_3\%$
module 4	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	m_4	$m_4\%$
module 5	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	m_5	$m_5\%$
module 6	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	m_6	$m_6\%$
module 7	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	m_7	$m_7\%$
module 8	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	m_8	$m_8\%$
module 9	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	m_9	$m_9\%$
level variables	l_1	l_2	l_3	l_4	l_5	l_6		
level weight	$l_1\%$	$l_2\%$	$l_3\%$	$l_4\%$	$l_5\%$	$l_6\%$		N

Problem Statement

Given a set $S = \{N, m, n, M, L, w_1, w_2\}$ where N is the number of marks allotted, m is the number of modules, n is the number of levels of taxonomy, $M = \langle m_1, m_2, \dots, m_m \rangle$ is the vector of module weights where m_i is the weight assigned to the i^{th} module, $L = \langle l_1, l_2, \dots, l_n \rangle$ is the vector of level weights where l_j is the weight assigned to the j^{th} level, w_1, w_2 are the Module Fitness Weights and Level Fitness Weights assigned by the question paper setter to give degree of importance to the module wise weights and level wise weights respectively in a Question Paper. The problem is to generate a template, $T = \{(S), X\}$ where $X = \langle x_{11}, x_{12}, x_{1j}, \dots, x_{mm} \rangle$ such that x_{ij} is the marks assigned to the j^{th} level of i^{th} module. For a module i , $\sum x_{ij} = m_i$ for $j=1$ to n and for a level j , $\sum x_{ij} = l_j$ for $i=1$ to m .

Fitness of a Question Paper Template (F)

$$F = (w_1 * \sum F_{\text{module}} + w_2 * \sum F_{\text{level}}) / (w_1 + w_2),$$

where F_{module} and F_{level} denote the fitness value of a module and fitness value of a level respectively. The details of F_{module} and F_{level} are given below:

$F_{\text{module}} = \sum (1 - WM_i) / m$, where WM_i is the weakness of i^{th} module and is calculated as follows-

$$WM_i = (\sum |x'_{ij} - l_j|) / N, \text{ for } j=1 \text{ to } n, \text{ where } x'_{ij} = x_{ij} * N / m_i.$$

$F_{\text{level}} = \sum (1 - WL_j) / n$, where WL_j is the weakness of j^{th} level and is calculated as follows-

$$WL_j = (\sum |x''_{ij} - u_i|) / N, \text{ for } i=1 \text{ to } m, \text{ where } x''_{ij} = x_{ij} * N / l_j$$

Template Types

7

1) Standard Template –High Difficulty Level

- ❖ Template with high distribution of marks across higher/difficult levels of taxonomy.
- ❖ Fitness value in the range of 0.8 to 1.00.

2) Standard Template –Medium Difficulty Level

- ❖ Template with proportionate distribution of marks across all levels of taxonomy .
- ❖ Fitness value normally in the range 0.8 to 1.00.

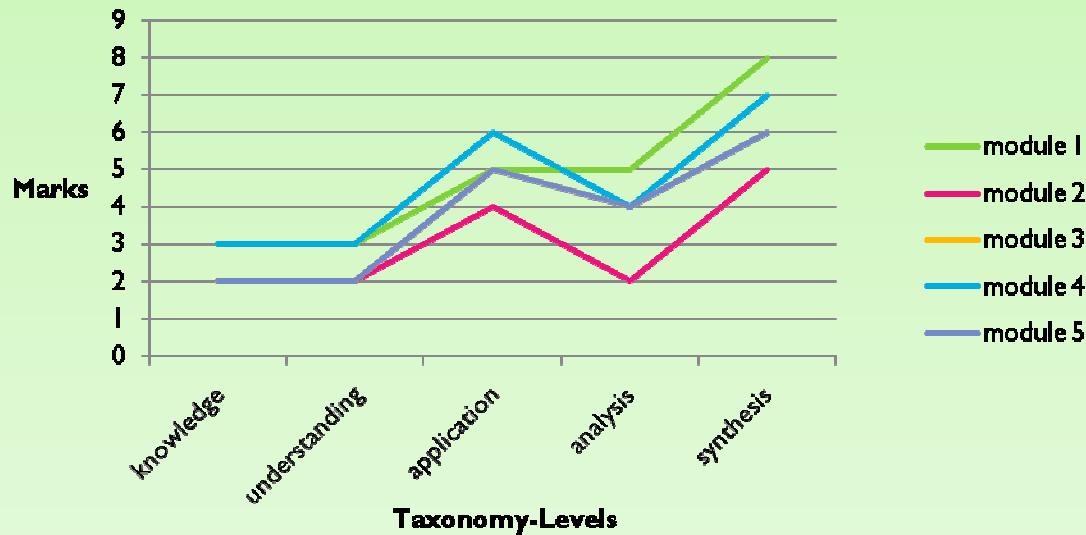
3) Standard Template –Low Difficulty Level

- ❖ Template with low distribution of marks across higher/difficult levels of taxonomy.
- ❖ Fitness value in the range of 0.8 to 1.00.

Standard Template–High Difficulty Level

level/module	knowledge	understanding	application	analysis	synthesis	Module weights	module weakness	module fitness
module 1	3	3	5	5	8	24	0.0833	0.1833
module 2	2	2	4	2	5	15	0.1133	0.1773
module 3	2	2	5	4	6	19	0.0674	0.1865
module 4	3	3	6	4	7	23	0.0635	0.1873
module 5	2	2	5	4	6	19	0.0674	0.1865
level weights	12	12	25	19	32	100		
level weakness	0.3363	0.3363	0.4895	0.3078	0.8843			
level fitness	0.1327	0.1327	0.1021	0.1384	0.0231			

Standard Template-High Difficulty Level



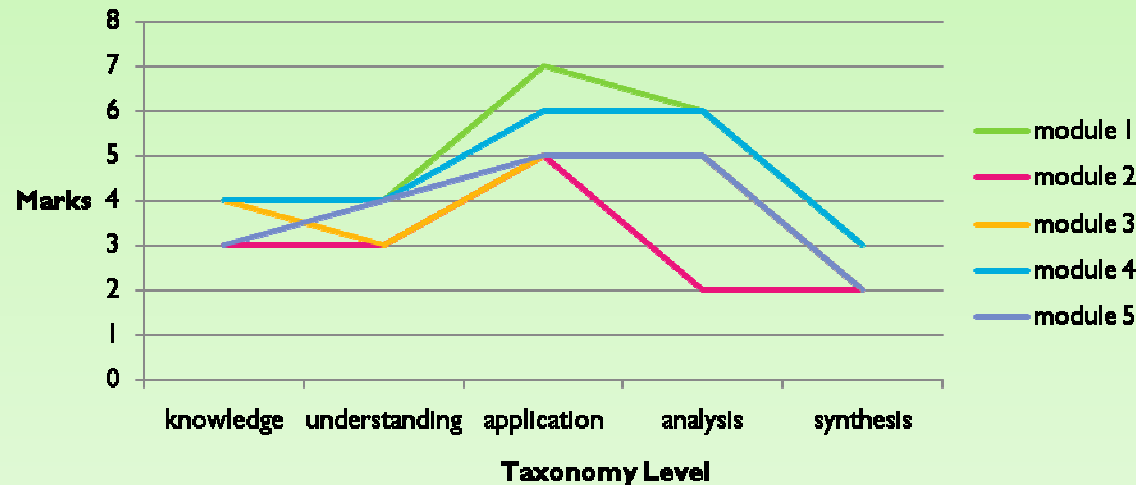
$w1=0.5, w2=0.5$
 $\Sigma F_{\text{module}}, \text{Module Fitness} = 0.9209$
 $\Sigma F_{\text{level}}, \text{Level Fitness} = 0.9209$
 $F, \text{Template Fitness} = 0.9209$

$X_{ij} = (m_i * I_j) / N,$
 where, X_{ij} can be non-integer values.

Standard Template–Medium Difficulty Level 9

level/module	knowledge	understanding	application	analysis	synthesis	Module weights	module weakness	Module fitness
module 1	4	4	7	6	3	24	0.0533	0.1893
module 2	3	3	5	2	2	15	0.2133	0.1573
module 3	4	3	5	5	2	19	0.1074	0.1785
module 4	4	4	6	6	3	23	0.0626	0.1875
module 5	3	4	5	5	2	19	0.1074	0.1785
level weights	18	18	28	24	12	100		
level weakness	0.2049	0.324	0.5348	0.3903	0.3591			
Level fitness	0.159	0.1352	0.093	0.1219	0.1282			

Standard Template-Medium Difficulty Level



$$w_1=0.5, w_2=0.5$$

$$\Sigma F_{\text{module}}, \text{Module Fitness} = 0.8921$$

$$\Sigma F_{\text{level}}, \text{Level Fitness} = 0.8921$$

$$F, \text{Template Fitness} = 0.8921$$

$$x_{ij} = (m_i * I_j) / N,$$

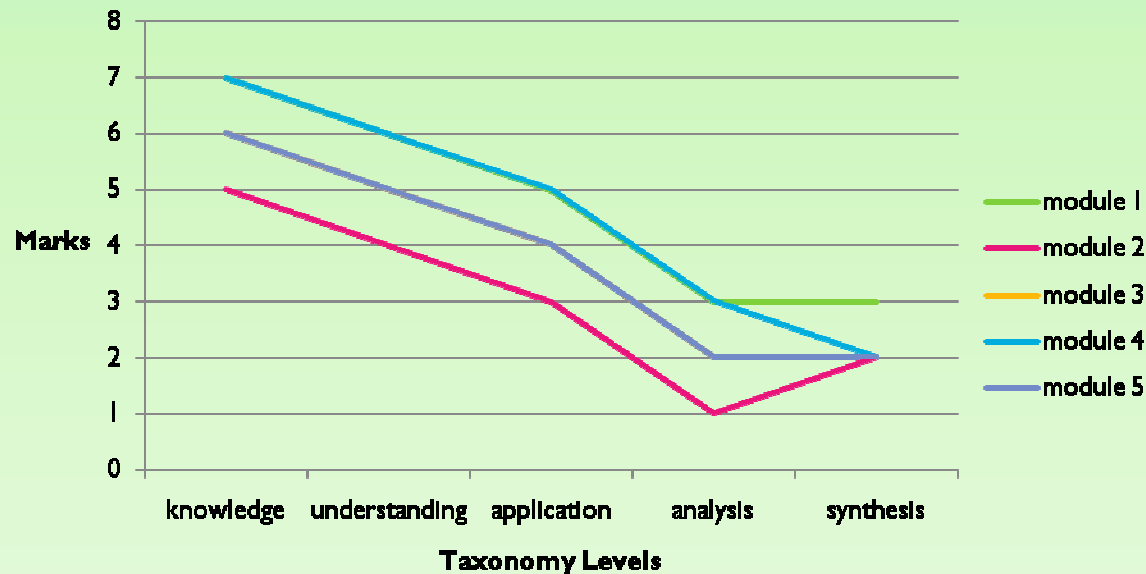
where, x_{ij} can be non-integer values.

Fitness Calculation

Standard Template–Low Difficulty Level

level/module	knowledge	understanding	application	analysis	synthesis	Module weights	module weakness	module fitness
module 1	7	6	5	3	3	24	0.06	0.188
module 2	5	4	3	1	2	15	0.1067	0.1787
module 3	6	5	4	2	2	19	0.0189	0.1962
module 4	7	6	5	3	2	23	0.0574	0.1885
module 5	6	5	4	2	2	19	0.0189	0.1962
module weights	31	26	21	11	11	100		
module weakness	0.914	0.6784	0.512	0.4004	0.3674			
module fitness	0.0172	0.0643	0.0976	0.1199	0.1265			

Standard Template -Low Difficulty Level



$w_1=0.5, w_2=0.5$
 $\Sigma F_{\text{module}}, \text{Module Fitness} = 0.9476$
 $\Sigma F_{\text{level}}, \text{Level Fitness} = 0.9476$
 $F, \text{Template Fitness} = 0.9476$

$$x_{ij} = (m_i * l_j) / N,$$
 where, x_{ij} can be non-integer values.

Module 2 : Question Selector

11

A question selector :

- ❖ select all possible question vectors for each element/cell of the template.
- ❖ Assist in generating multiple question sets for a given template.

Table 3. Sample Question Selector

level/module	knowledge	understanding	application	analysis	synthesis	module weights
module1	2 [1(2)]/[2(1)]	1 [1(1)]	2 [1(2)]/[2(1)]	3 [1(3)]/[2(1),1(1)]	2 [1(2)]/[2(1)]	10
module2	4 [1(4)]/[1(2)2(1)]/[2(2)]/[1(1)3(1)]/[4(1)]	2 [1(2)]/[2(1)]	5 [1(5)]/[1(3),2(1)]/[1(1)2(2)]/[2(1)3(1)]/[1(1)4(1)]/[5(1)]	6 [1(6)]/[2(3)]/[1(2)2(2)]/[1(3)3(1)]/[3(2)]/[1(2)4(1)]/[2(1)4(1)]/[1(1)5(1)]/[6(1)]	3 [1(3)]/[2(1),1(1)]	20
module3	6 [1(6)]/[2(3)]/[1(2)2(2)]/[1(3)3(1)]/[3(2)]/[1(2)4(1)]/[2(1)4(1)]/[1(1)5(1)]/[6(1)]	3 [1(3)]/[2(1),1(1)]	7 [1(7)]/[2(3)1(1)]/[1(3)2(2)]/[1(4)3(1)]/[3(2)1(1)]/[1(3)4(1)]/[2(1)5(1)]/[1(2)5(1)]/[6(1)1(1)]/[7(1)]	9 [1(9)]/[1(7)2(1)]/[1(4)2(2)1(1)]/[1(3)2(3)]/[1(4)2(1)1(1)]/[2(4)1(1)]/[2(1)3(2)1(1)]/[4(2)1(1)]/[1(5)4(1)]/[1(2)2(2)3(1)]/[3(3)]/[1(4)5(1)]/[1(2)2(1)5(1)]/[2(2)5(1)]/[1(1)3(1),5(1)]/[1(3)6(1)]/[1(1)2(1)6(1)]/[3(1)6(1)]/[1(2)7(1)]/[2(1)7(1)]/[1(1)8(1)]/[9(1)]	5 [1(5)]/[1(3),2(1)]/[1(1)2(2)]/[2(1)3(1)]/[1(1)4(1)]/[5(1)]	30
module4	3 [1(3)]/[2(1),1(1)]	2 [1(2)]/[2(1)]	4 [1(4)]/[1(2)2(1)]/[2(2)]/[1(1)3(1)]/[4(1)]	4 [1(4)]/[1(2)2(1)]/[2(2)]/[1(1)3(1)]/[4(1)]	2 [1(2)]/[2(1)]	15
module5	5 [1(4)]/[1(2)2(1)]/[1(1)3(1)]/[4(1)]	2 [1(4)]/[1(2)2(1)]/[1(1)3(1)]/[4(1)]	7 [1(7)]/[2(3)1(1)]/[1(3)2(2)]/[1(4)3(1)]/[3(2)1(1)]/[1(3)4(1)]/[2(1)5(1)]/[1(2)5(1)]/[6(1)1(1)]/[7(1)]	8 [1(8)]/[1(6)2(1)]/[1(4)2(2)]/[1(2)2(3)]/[1(3)2(1)3(1)]/[2(4)]/[2(1)3(2)]/[4(2)]/[1(4)4(1)]/[1(1)2(2)3(1)]/[1(2)3(2)]/[1(3)5(1)]/[1(1)2(1)5(1)]/[1(2)2(1)5(1)]/[3(1),5(1)]/[1(2)6(1)]/[2(1)6(1)]/[1(1)7(1)]/[8(1)]	3 [1(3)]/[2(1),1(1)]	25
level weights	20	10	25	30	15	100

Question Paper Generator

12

A question paper Generator :

- ❖ Generate user defined number of question paper sets with specified overlap using question vectors and Question Bank.

Table 4. Sample Question Paper Generator

level/module	knowledge	understanding	application	analysis	synthesis	module weights
module1	2 [1(2)]	1 [1(1)]	2 [2(1)]	3 [3(1)]	2 [2(1)]	10
module2	4 [4(1)]	2 [2(1)]	5 [4(1)]1(1)]	6 [2(3)]	3[1(3)]	20
module3	6 [6(1)]	3 [3(1)]	7 [6(1)1(1)]	9 [6(1)3(1)]	5 [4(1)1(1)]	30
module4	3 [1(2)1(1)]	2 [2(1)7(1)]	4 [4(1)]	4 [3(1)1(1)]	2[2(1)]	15
module5	5[1(3)2(1)]	2 [2(1)]	7 [4(1)2(1)1(1)]	8 [4(2)]	3 [3(1)]	25
Level weights	20	10	25	30	15	100

Module 3 : Question Extractor

13

- ❖ **Future Work**
- ❖ **Feedback / Suggestions**

Thank You.