

Birla Institute of Technology & Science, Pilani

Work Integrated Learning Programmes Division
M. Tech (Software Engineering) at Wipro Technologies (WASE)
II Semester 2015 - 2016

Comprehensive Examination (Makeup) ANSWER KEY

Course Number	: SEWP ZC322	<table border="1"><tr><td>No. of Pages</td><td>:4</td></tr><tr><td>No. of Questions</td><td>: 6</td></tr></table>	No. of Pages	:4	No. of Questions	: 6
No. of Pages	:4					
No. of Questions	: 6					
Course Title	: Data Base Management Systems					
Type of Exam	: Open Book					
Weightage	: 60 %					
Duration	: 3 Hours					
Date of Exam	: 3 rd August, 2016	Session : FN(9 to 12 Noon)				

Note:

1. Please read and follow all the instructions given on the cover page of the answerscript.
 2. Start each answer from a fresh page. All parts of a question should be answered consecutively.
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Q1 (Marks 10)

Consider the following information about a university database:

- Professors have an SSN, a name, an age, a rank, and a research specialty.
- Projects have a project number, a sponsor name (e.g., NSF), a starting date, an ending date, and a budget.
- Graduate students have an SSN, a name, an age, and a degree program (e.g., M.S. or Ph.D.).
- Each project is managed by one professor (known as the project's principal investigator).
- Each project is worked on by one or more professors (known as the project's co-investigators).
- Professors can manage and/or work on multiple projects.
- Each project is worked on by one or more graduate students (known as the project's research assistants).
- When graduate students work on a project, a professor must supervise their work on the project. Graduate students can work on multiple projects, in which case they will have a (potentially different) supervisor for each one.
- Departments have a department number, a department name, and a main office.
- Departments have a professor (known as the chairman) who runs the department.
- Professors work in one or more departments, and for each department that they work in, a time percentage is associated with their job.
- Graduate students have one major department in which they are working on their degree.
- Each graduate student has another, more senior graduate student (known as a student advisor) who advises him or her on what courses to take.
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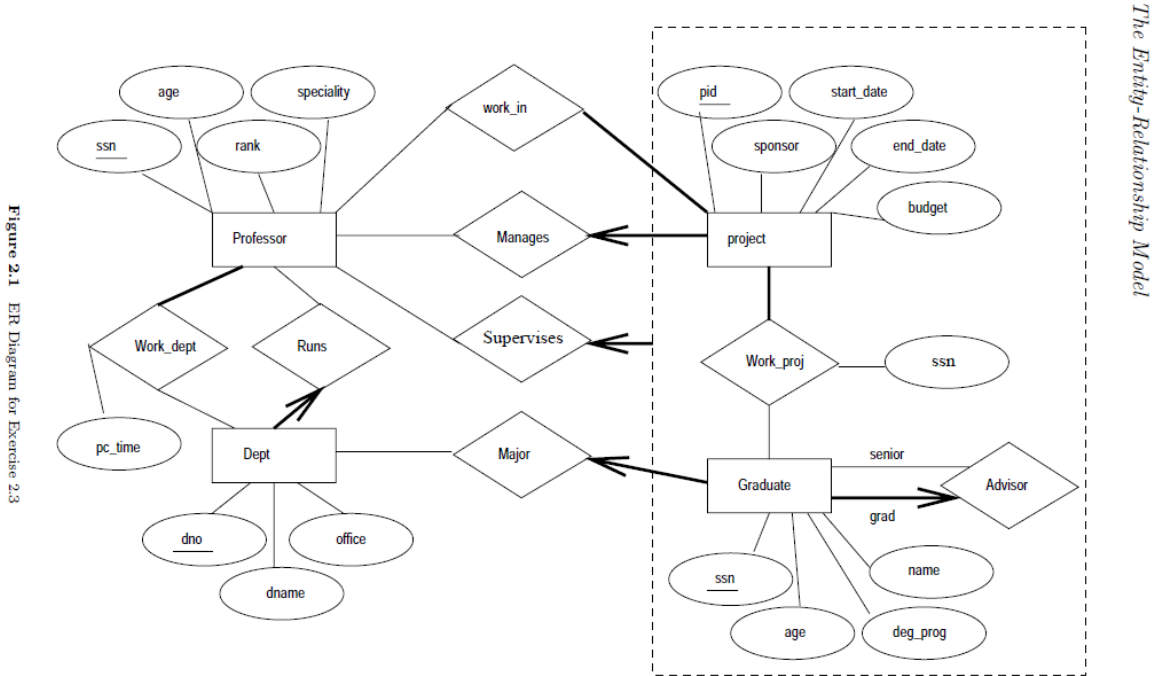
Design and draw an ER diagram that captures the information about the university. Use only the basic ER model here, that is, entities, relationships, and attributes. Be sure to indicate any key and participation constraints.

ER Diagram

Evaluation of marks are based upon showing ER Diagram, Cardinality ratio, Keys. No Partial Marks should be offered

Entities correctly identified: [3 Mark]
 Attributes correctly identified: [2 Mark]
 Primary keys correctly identified: [1 Mark]
 Relationships and cardinality correctly identified: [4 Mark]

ER/ERR Schema (variations are possible to this answer)



Q2: (10 Marks)

Consider the following relations:

Student(*snum*: integer, *sname*: string, *major*: string, *level*: string, *age*: integer)

Class(*name*: string, *meets at*: string, *room*: string, *fid*: integer)

Enrolled(*snum*: integer, *cname*: string)

Faculty(*fid*: integer, *fname*: string, *deptid*: integer)

The meaning of these relations is straightforward; for example, Enrolled has one record per student-class pair such that the student is enrolled in the class.

Write the following queries in SQL. No duplicates should be printed in any of the answers.

- Find the names of all Juniors (level = JR) who are enrolled in a class taught by I. Teach.
- Find the age of the oldest student who is either a History major or enrolled in a course taught by I. Teach.
- Find the names of all classes that either meet in room R128 or have five or more students enrolled.
- Find the names of all students who are enrolled in two classes that meet at the same time.

5. Find the names of faculty members who teach in every room in which some class is taught.

The answers are given below: (2 marks Each total 10 Marks)

```
1. SELECT DISTINCT S.Sname
FROM Student S, Class C, Enrolled E, Faculty F
WHERE S.snum = E.snum AND E.cname = C.name AND C.fid = F.fid AND
F.fname = 'I.Teach' AND S.level = 'JR'
```

```
2. SELECT MAX(S.age)
FROM Student S
WHERE (S.major = 'History')
OR S.snum IN (SELECT E.snum
FROM Class C, Enrolled E, Faculty F
WHERE E.cname = C.name AND C.fid = F.fid
AND F.fname = 'I.Teach' )
```

```
3. SELECT C.name
FROM Class C
WHERE C.room = 'R128'
OR C.name IN (SELECT E.cname
FROM Enrolled E
GROUP BY E.cname
HAVING COUNT (*) >= 5)
SQL: Queries, Constraints, Triggers 47
```

```
4. SELECT DISTINCT S.sname
FROM Student S
WHERE S.snum IN (SELECT E1.snum
FROM Enrolled E1, Enrolled E2, Class C1, Class C2
WHERE E1.snum = E2.snum AND E1.cname <> E2.cname
AND E1.cname = C1.name
AND E2.cname = C2.name AND C1.meets at = C2.meets at)
```

```
5. SELECT DISTINCT F.fname
FROM Faculty F
WHERE NOT EXISTS (( SELECT *
FROM Class C )
EXCEPT
(SELECT C1.room
FROM Class C1
WHERE C1.fid = F.fid ))
```

Q3A (2.5 For Each total 5 Marks)

Consider a database with objects X and Y and assume that there are two transactions T_1 and T_2 . Transaction T_1 reads objects X and Y and then writes object X . Transaction T_2 reads objects X and Y and then writes objects X and Y .

1. Give an example schedule with actions of transactions T_1 and T_2 on objects X and Y that results in a write-read conflict.

2. Give an example schedule with actions of transactions T_1 and T_2 on objects X and Y that results in a read-write conflict.

The answer to each question is given below:- (2.5 For Each total 5 Marks)

1. The following schedule results in a write-read conflict:

$T_2:R(X), T_2:R(Y), T_2:W(X), T_1:R(X) \dots$

$T_1:R(X)$ is a dirty read here.

2. The following schedule results in a read-write conflict:

$T_2:R(X), T_2:R(Y), T_1:R(X), T_1:R(Y), T_1:W(X) \dots$

Now, T_2 will get an unrepeatable read on X .

Now, T_2 has overwritten uncommitted data.

Q.3 B) Consider the following two tables T_1 and T_2 . Show the results of the following operations:

Table T_1

P	Q	R
10	a	5
15	b	8
25	a	6

Table T_2 :

A	B	C
10	B	6
25	C	3
10	B	5

Answers:

(a) $T_1 \bowtie T_1.P = T_2.A$ T_2 (1Marks)

P	Q	R	A	B	C
10	A	5	10	b	6
10	A	5	10	b	5
25	A	6	25	c	3

(b) $T_1 \bowtie T_1.Q = T_2.B$ T_2 (1Marks)

P	Q	R	A	B	C
15	B	8	10	B	6
15	B	8	10	B	5

(c) $T_1 \cup T_2$ (1Marks)

P	Q	R
10	A	5
15	B	8
25	A	6
10	B	6
25	C	3
10	B	5

(d) ~~T1~~ (T1.P=T2.A AND T1.R=T2.C)T2 (2Marks)

P	Q	R	A	B	C
10	A	5	10	B	5

Q4 (10 Marks)

Construct a B+ tree with given specifications. The order of the tree, $p=3$ and $p_{leaf}=2$. The tree should be such that all the keys in the subtree pointed by a pointer which is preceding the key must be equal to or less than the key value, and all the keys in the subtree pointed by a pointer which is succeeding the key must be greater than the key.

Insert the following keys in same order- 56, 22, 78, 42, 102, 90, 96, 35. Show how the tree will expand after each insertion, and the final tree.

Next, delete 56, 46, 22 in the same order and show the status of the tree after each deletion.

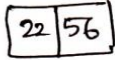
Ans:-

Note:- there is a typo this is answer of Question 4

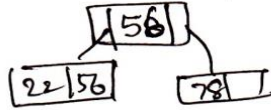
Q5 (a) B+ Tree P=3 Pfleaf=2

Keys - 56, 22, 78, 42, 102, 90, 96, 35

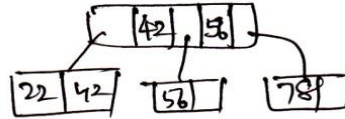
Insert 56, 22



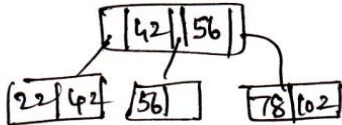
Insert 78



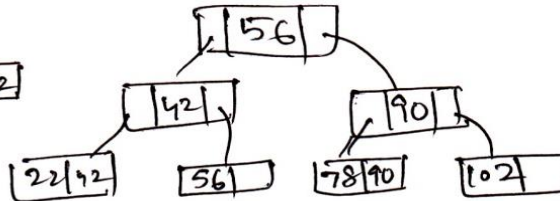
Insert 42



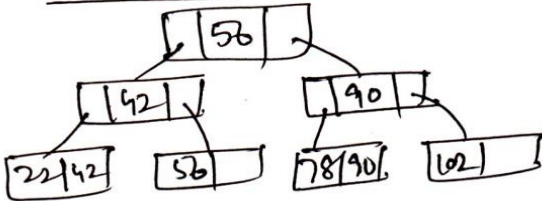
Insert 102



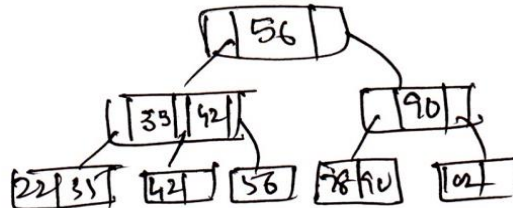
Insert 90



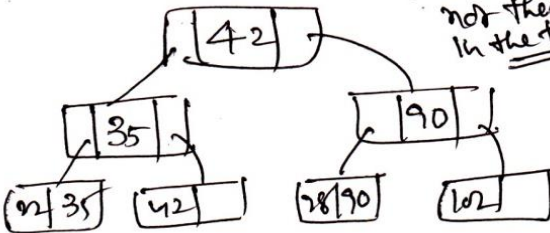
Insert 96



Insert 35



Delete 56

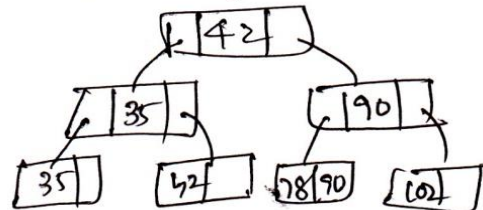


Delete 46

not there
in the tree

Final tree

Delete ~~46~~



Final tree

Q.5A. Consider the universal relation $R = \{A, B, C, D, E, F, G, H, I, J\}$ and the set of FDs $F = \{\{A, B\} \rightarrow \{C\}, \{A\} \rightarrow \{D, E\}, \{B\} \rightarrow \{F\}, \{F\} \rightarrow \{G, H\}, \{D\} \rightarrow \{I, J\}\}$ (5Marks)

$D3 = \{R1, R2, R3, R4, R5\}$;

$R1 = \{A, B, C, D\}$,

$R2 = \{D, E\}$,

$R3 = \{B, F\}$,

$R4 = \{F, G, H\}$,

$R5 = \{D, I, J\}$

Determine whether each decomposition has

- (1) the dependency preservation property, and
- (2) the lossless join property, with respect to F .

Answer: 1.dependency preservation property is not there as $A \rightarrow D, E$ is not preserved based on $R1$ (2.5 Marks)

2 Lossless join property is not there. (2.5 Marks)

A	B	C	D	E	F	G	H	I	J
a1	a2	a3	a4	b15	B16/a6	B17/a7	B18/a8	B19/a9	B20/a10
b21	b22	b23	a4	a5	b26	b27	b28	b29	b30
b31	a2	b33	b34	b35	a6	b37	b38	b39	b40
b41	b42	b43	b44	b45	a6	a7	a8	b49	b50
b51	b52	b53	a4	b55	b56	b57	b58	a9	a10

Q5B We have a file sorted on Primary key (PK), the key size is 10 bytes, the record length is 101 bytes and the record pointer takes 8 bytes and block pointer takes 6 bytes. The disk block size is 512 bytes. Assuming there are 50000 ordered records in the file.

Use the above information and answer the following questions:

(1 Marks Each total 5 Marks)

- (i). Calculate the blocking factor and the number of file blocks assuming an unspanned organization (1 Mark)

Answer:

Blocking factor $bfr = \text{floor}(B/R) = \text{floor}(512/101) = 5 \text{ records per block}$
Number of blocks needed for file = $\text{ceiling}(r/bfr) = \text{ceiling}(50000/5) = 10000$

- ii) calculate the index blocking factor(1 Mark)

Index record size $R_i = (V \text{ PK} + \text{blockpointer}) = (10 + 6) = 16 \text{ bytes}$
Index blocking factor $bfri = fo = \text{floor}(B/R_i) = \text{floor}(512/16) = 32$

- iii. Calculate the no. of first level index entries and first level index blocks(1 Mark)

Number of first-level index entries $r_1 = \text{number of file blocks } b = 10000 \text{ entries}$
Number of first-level index blocks $b_1 = \text{ceiling}(r_1 / bfri) = \text{ceiling}(10000/32) = 312 \text{ blocks}$

- iv) If we consider multilevel index, how many levels are possible. (1 Mark)

Number of second-level index entries $r_2 = \text{number of first-level blocks } b_1 = 312 \text{ entries}$
Number of second-level index blocks $b_2 = \text{ceiling}(r_2 / bfri) = \text{ceiling}(312/32) = 9 \text{ blocks}$

Number of third-level index entries r_3 = number of second-level index blocks $b_2=9$
 Number of third-level index blocks $b_3 = \text{ceiling}(r_3 / \text{bfri}) = \text{ceiling}(9/32) = 1$
 Since the third level has only one, max level possible are 3

v) total no. of blocks required by the multi level index(1 Mark)

Total number of blocks for the index $b_i = b_1 + b_2 + b_3 = 312 + 9 + 1=322$ blocks

Q.6

(2+4+4=10 Marks)

<p>Consider the execution shown in Figure In addition, the crashes system during recovery after writing two log records to stable storage and again after writing another two log records.</p> <p>1. What is the value of the LSN stored in the master log record?</p> <p>2. What is done during Analysis?</p> <p>3. What is done during Redo?</p>	<table border="0"> <thead> <tr> <th style="text-align: left;">LSN</th> <th style="text-align: center;"> </th> <th style="text-align: left;">LOG</th> </tr> </thead> <tbody> <tr><td>00</td><td style="text-align: center;"> </td><td>begin_checkpoint</td></tr> <tr><td>10</td><td style="text-align: center;"> </td><td>end_checkpoint</td></tr> <tr><td>20</td><td style="text-align: center;"> </td><td>update: T1 writes P1</td></tr> <tr><td>30</td><td style="text-align: center;"> </td><td>update: T2 writes P2</td></tr> <tr><td>40</td><td style="text-align: center;"> </td><td>update: T3 writes P3</td></tr> <tr><td>50</td><td style="text-align: center;"> </td><td>T2 commit</td></tr> <tr><td>60</td><td style="text-align: center;"> </td><td>update: T3 writes P2</td></tr> <tr><td>70</td><td style="text-align: center;"> </td><td>T2 end</td></tr> <tr><td>80</td><td style="text-align: center;"> </td><td>update: T1 writes P5</td></tr> <tr><td>90</td><td style="text-align: center;"> </td><td>T3 abort</td></tr> <tr><td></td><td style="text-align: center;">X</td><td>CRASH, RESTART</td></tr> </tbody> </table>	LSN		LOG	00		begin_checkpoint	10		end_checkpoint	20		update: T1 writes P1	30		update: T2 writes P2	40		update: T3 writes P3	50		T2 commit	60		update: T3 writes P2	70		T2 end	80		update: T1 writes P5	90		T3 abort		X	CRASH, RESTART
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Q.6 Ans:-

1). LSN 00 is stored in master log record. It is the LSN of the begin checkpoint record. (2 Marks)

2). At the end of analysis, the transaction table contains the following entries: (T1,80), and (T3,60). The Dirty Page Table has the following entries: (P1,20), (P2,30), (P3,40), and (P5,80)

LSN 20	Add (T1,20) to TT and (P1,20) to DPT
LSN 30	Add (T2,30) to TT and (P2,30) to DPT
LSN 40	Add (T3,40) to TT and (P3,40) to DPT
LSN 50	Change status of T2 to C
LSN 60	Change (T3,40) to (T3,60)
LSN 70	Remove T2 from TT
LSN 80	Change (T1,20) to (T1,70) and add (P5,70) to DPT
LSN 90	No action

(4 Marks)

3). Redo starts from LSN20 (minimum recLSN in DPT).

LSN 20	Check whether P1 has pageLSN more than 10 or not. Since it is a committed transaction, we
--------	---

	probably need not redo this update
LSN 30	Redo the change in P2
LSN 40	Redo the change in P3
LSN 50	No action
LSN 60	Redo the changes on P2
LSN 70	No action
LSN 80	Redo the changes on P5
LSN 90	No action

(4 Marks)