

End-SEMESTER EXAMINATION, JANUARY-2023
Design of operating Systems (CSE 4049)

Semester: 6th
 Time: 3 Hours

Programme: BTech
 Full Marks: 60

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
To understand the different components of operating System and various ways of structuring an operating system.	L2	1 a,b,c	6
To analyze the mechanisms involved in handling, scheduling, synchronizing processes and threads.	L4	2 a,b,c 3 a,b,c 4 a,b,c 5 a	20
To learn the different methods used to prevent and deal with deadlock	L4	5 b,c, 6 a,b,c	10
To explore various memory management, file handling and input output schemes, analyzing their effectiveness in different scenario.	L3	7 a,b,c 8 a,b,c 9 a,b,c	18
To gain knowledge about various data structures and functions used for process management, scheduling, synchronization, memory and file management in Linux operating system	L3	10 a,b,c	6

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

- Q1. (a) Describe the objective of multiprogramming. How time sharing system differs from multiprogrammed batched systems. 2
- (b) Differentiate between monolithic and modular kernel structure. 2
- (c) Explain the interrupt driven I/O with its two 2

limitations.

- ✓ ~~✓~~ Differentiate between medium term and long term scheduler. 2
- (b) Compare the direct indirect addressing scheme with respect to message passing scheme. 2
- ✓ ~~✓~~ What are the advantages of using multithreading instead of multiple processes? 2
- ✓ ~~✓~~ Differentiate between user level and kernel level thread. 2
- ✓ ~~✓~~ Explain the different states of a process with state diagram. 2
- ✓ ~~✓~~ Explain the race condition with an example. 2
- ✓ ~~✓~~ Consider the following set of processes with the length of the CPU burst given in milliseconds. 2

Process	Arrival time	Burst time	Priority
P1	0	4	3
P2	0	2	1
P3	1	3	2
P4	2	2	4

Draw the Gantt charts that illustrate the execution of these processes using the preemptive priority scheduling and find the number of context switching occurs here.

- ✓ ~~✓~~ Draw the Gant charts that illustrate the execution of the processes specified in 5(a) using HRRN scheduling and find the average turnaround time of the processes. - ~~✓~~ 2
- ✓ ~~✓~~ Write a semaphore solution to a bounded buffer producer consumer problem. 2
- ✓ ~~✓~~ (a) How does a monitor support synchronization? 2
- ✓ ~~✓~~ (b) What the necessary conditions for deadlock? 2
- ✓ ~~✓~~ Consider a system with 12 tapedrives and 3 processes: P0, P1, P2. P0 requires 4 tape drives, P1 requires 10 tapedrives, P2 requires 9 tapedrives for completing their task. Suppose at time t0, P0 is holding 2 tapedrives, P1

is holding 5 tapedrives and P2 is holding 2 tape drives. Then check whether the current resource allocation state is safe or not. If yes specify the safe sequence.

- ✓ ~~✓~~ (a) What are the protocols used to prevent deadlock by avoiding no preemption condition? 2

✓ ~~✓~~ (b)

	Allocation				Request			
	A	B	C	D	A	B	C	D
P0	0	1	1	0	0	0	1	0
P1	0	1	0	1	1	0	0	1
P2	1	2	0	0	0	0	0	1
P3	0	0	1	2	0	0	0	0
P4	1	0	1	0	0	1	0	0

Consider the above resource allocation state with 4 processes and 4 resources, and an available vector of <0100>. Check whether the system with the above resource allocation state is deadlock free or not.

✓ ~~✓~~ In the resource allocation state specified in 6(b), if P0 is assigned with 1 more instance of type B, then check whether the system is deadlock free or not. 2

✓ ~~✓~~ Define internal fragmentation. Find the internal fragmentation for a process with size 83412 bytes in a paging scheme with a 2KB page size. 2

- (b) Given four memory partitions of 200k, 600k, 400k, 700k (in order). How the first fit and best-fit algorithm would place processes of 312k, 517k, 212k, 526k (in order) in those partitions. 2

(c) Explain the address translation scheme of paging technique with a paging hardware. 2

8. (a) Consider a byte addressable system with physical address space of 128 byte, Logical address space of 64 byte and a page size of 16byte. If the page table entry is 3, 7, 8, 2, then what will be the physical address of logical address 31? 2

(b) Differentiate between equal and proportional frame allocation technique with example. 2

End Semester Examination, Jan-2023**Operating Systems Workshop (CSE 3541)****Programme: B.Tech./CSE)****Full marks: 60****Semester: 5th****Time: 3 hours**

Subject Learning Outcome	*Taxonomy Level	Question Number	Marks
understand C program terminologies and developing program to solve different computational problems	L4, L5	1a, 1b	5.5
become familiar with Unix shell commands, programs, processes, threads and thread of execution	L3, L4	2a, 2b	5.5
explore different Unix I/O techniques and able to design command(s) in the Unix shell environment	L3, L4	3a, 3b	5.5
learn the fundamentals of signal handling and timers used in Unix operating system			
understand thread creation, management, synchronization and apply it in realistic applications	L4, L5	4a, 5b	5.5
become familiar with basic IPC issues and communication techniques in Unix systems programming	L3, L4, L4, L5	4a, 4b, 5a, 5b	5.5, 5.5

*Blooms taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. All questions carry equal marks. All bits of each question carry equal marks.

The figures in the right side indicate marks.

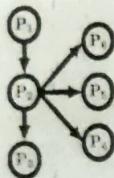
1. Write a C program to find whether the array of integers given is in fibonacci order or not. The code should take the input from the file, **array.txt**, using input redirection(<>) or any other file handling method. The first number of the file describes the number of integers in the array and other numbers represent the elements of the array.

~~Use malloc () to allocate array at runtime.~~

[5]

✓(a) Use a recursive function to find the sum of the array if the array is in fibonacci order. [5]

✓(b) Write a code to generate the following correlated processes where arrow indicate parent child relation.



✓(a) Use wait function to avoid creation of any zombie process. [5]

✓(b) Each process created must print its own id and parent id once before exiting. [5]

✓(c) Write a program to copy the content of "in.txt" by capitalizing all characters to a non existing file "out.txt" using file descriptor functions.

✓(d) While opening the existing file "out.txt" in write mode. The newly created file must provide the owner read-write permission , group user and others read permission only. Fill all the "?" to achieve the above objective. [5]

```

int fd;
mode_t fdmode = (?? | ?? | ?? | ??);
fd = open("out.txt", ?? | O_CREAT, fdmode);
if (fd == -1)
    perror("Failed to open info.dat");
  
```

✓(b) Do not use any inbuilt function to capitalize each character. [5]

✓(c) Write a parent child code where the child receives a string from the user and shares it to the parent using pipe.

✓(d) Create the unnamed pipe before the call to fork(). [5]

✓(b) Child must close the read end of pipe and parent must close the write end of the pipe before asking the user for input. [5]

✓(c) Design two programs in C named "collector.c" and "modifier.c".

✓(a) "collector.c" takes a string as an input from the user and stores it in a shared memory location. [5]

✓(b) "modifier.c" reads the data form shared memory and concatenates (without using string concatenation function) with the string "ITER" and displays the output. [5]

6. Use semaphore call to solve the following programming code so that it will print
010101010101....

```

int main()
{
    if(fork() == 0){
        for(int i=0;i<10;i++){
            fprintf(stderr,"1"); sleep(0.5);
            fprintf(stderr,"1"); sleep(1.0);
        }
    }
    else{
        for(int i=0;i<10;i++){
            fprintf(stderr,"0"); sleep(1.0);
            fprintf(stderr,"0"); sleep(0.6);
        }
    }
}
  
```

(a) Define an unnamed semaphore for the parent and child process. [5]

(b) Make sure that no zombie process is created. [5]

- b) In mathematical language, a list of 7 elements is often called a 2-tuple. Hence, define a Turing machine to be a 7-tuple.
- c) Give implementation-level description of Turing machine that decides the following language over the alphabet {0,1} 2
 $L = \{w \mid w \text{ is a string containing any number of } 1\text{'s followed by same number of } 0\text{'s}\}$
9. a) Construct the Turing machine that will decide the language L= 2
 $\{w \# w \mid w \in \{0, 1\}^*\}$
- b) Show the sequence of configuration of the Turing machine obtained in Q.9 (a) for processing the input string $w=010\#010$ 2
- f) Two models are said to be equivalent, if they recognize the same class of languages. Illustrate the process of converting a multitape Turing machine to its equivalent single-tape Turing machine. 2
10. a) Compare and contrast between Turing recognizable language and Turing decidable language. 2
- b) Let $A_{REX}=\{<R,w> \mid R \text{ is a regular expression that generates string } w\}$. Show that A_{REX} is a decidable language. 2
- c) What is undecidable language? Give some examples of Undecidable language. 2

***** End of Questions *****

END-SEMESTER EXAMINATION, January-2023
Theory of Computation (CSE3031)

Programme: B.Tech.
 Full Marks: 60

Semester: V
 Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Able to enhance/develop the ability to understand and conduct mathematical proofs for computation and algorithms.	L1, L2	1. a),b)	4
Able to design and analyze finite automata, and regular expression for describing regular languages.	L1, L3, L5, L6	2. a),b),c), 3. a),b),c) 4. a),b),c)	18
Design and analyze pushdown automata, and context-free grammars.	L1, L2, L3, L5	5. a),b),c) 6. a),b),c) 7. a),b),c)	18
Design and analyze Turing machines.	L1, L2, L3, L5	8. b),c) 9. a),b),c)	10
Enhance the ability to understand the decidability criteria of various computational problems.	L2, L3, L4, L5	10.a),b),c)	6
Demonstrate the understanding of key notions, such as algorithm, computability and complexity through problem solving.	L1, L6	1. c), 8. a)	4

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

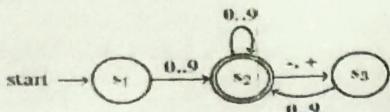
Answer all questions. Each question carries equal mark.

1. a) Differentiate between Sequence and Tuple with example. 2
- b) Let $C(n) = 1^3 + 2^3 + 3^3 + \dots + n^3$ be the sum of the first n cubes. 2
 Prove the following equalities by method of induction,

$$C(n) = \frac{1}{4}(n^4 + 2n^3 + n^2) = \frac{1}{4}n^2(n + 1)^2$$

Q1 For the Finite State Machine given below which of these inputs are valid (State with reason):

- (i) 987654321+994.0
- (ii) 5.5+2*4
- (iii) 9+8+7+6+4+3+2+1
- (iv) 0+1+2+1+



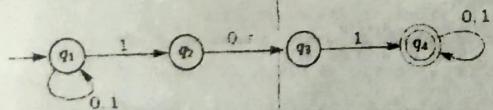
Q2 Build a deterministic finite automaton over $\Sigma = \{\text{RESET}, 0, 1, 2\}$ such that it accepts all strings in which the sum of digits is a multiple of 3. <RESET> is a single symbol that resets the sum to 0 whenever encountered at any state.

b) Demonstrate that regular language is closed under complement operation by constructing a DFA that accept all strings w over $\Sigma = \{0, 1\}$ not containing "011" as substring.

c) Illustrate the state transition diagram of NFA that recognizes the language containing all strings where the number of a's are multiple of 2 or 3 over the alphabet $\Sigma = \{a, b\}$.

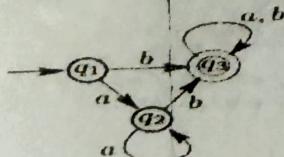
3. d) Illustrate the state transition diagram for an NFA- ϵ recognizing the regular expression: $(0 \cup 1)^* 010$ following the appropriate procedure.

b) Find an equivalent DFA for the NFA given below. Write all the states that are unreachable from the initial state. How many final states are there in the converted DFA?



c) Show the computation of the DFA constructed in Q.3 (b) on the input string 101101.

4. a)



Design a Generalized-NFA (GNFA) for the above Deterministic Finite Automata (DFA). Find the equivalent regular expression from the GNFA constructed using the state elimination method.

b) Using method of contradiction, show that the language given below is not a regular language.
 $A = \{w | w = ap \text{ where } p \text{ is a prime number}\}$

c) Explain the closure properties of regular languages.

$$\begin{aligned} & S^* - S^* \\ & \Rightarrow aS^* | bS^* \\ & \Rightarrow a^n * | b^n * \\ & \Rightarrow a^n * C | b^n * C \end{aligned}$$

d) Build the context free grammar for the language $L = \{a^i b^j c^k | i=j \text{ or } i=k \text{ where } i, j, k \geq 1\}$

b) The grammar obtained in Q.5.a) is ambiguous or unambiguous? Justify your answer considering the string $w = aabbcc$

c) Construct the equivalent Pushdown Automaton that will recognize the language defined in Q.5.a)

6. a) Consider the following CFG;

$$\begin{aligned} E &\rightarrow E + T \mid T \\ T &\rightarrow T * F \mid F \\ F &\rightarrow \{E\} \mid a \end{aligned}$$

Build the derivation and the parse tree for the string " $a + (a) * a$ ".

b) Using pumping lemma for context free language, prove that the language $A = \{a^n b^n c^n | n \geq 0\}$ is not a context free language.

c) Explain the Chomsky classification of grammars with equivalent machines and languages. Also, give the example of languages correspondent to each class of grammars.

7. a) Let G be the following context-free grammar;

$$\begin{aligned} S &\rightarrow AABC \\ A &\rightarrow aAb \mid \epsilon \\ B &\rightarrow aB \mid a \\ C &\rightarrow aCa \mid bDb \mid \epsilon \end{aligned}$$

Eliminate the ϵ rules from G.

b) Eliminate any unit rules present in the resulting grammar obtained in Q.7 a).

c) Put the resulting grammar obtained in Q.7 b) in Chomsky Normal Form (CNF).

8. a) Define Church-Turing thesis? Can you relate an algorithm to a Turing machine? Justify.

$$\begin{aligned} P &- \\ S - aTc &| \\ T - Tb &| b \\ K - aKc &| T \end{aligned}$$

APP

↓

Prac

↓

Session

↓

Transport

1101 10101010010 |
 1101
 01111
 1101
 001000
 01000
 10001

1101 10101010010
 1101
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 1101
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END SEMESTER EXAMINATION, JANUARY-2023
COMPUTER NETWORKING (CSE 3034)

Programme: B.Tech (CSE, CSIT)

Full Marks: 60

Semester: 5th

Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
CO1 -Able to understand the architectural principles of computer networking and compare different approaches to organising networks	L1, L2, L3	1(a), 1(b), 1(c), 2(a), 1(b), 2(c)	12
CO2 -Able to analyze the physical characteristics and functions of the physical devices and interfaces so that transmission can occur in different transmission medium.	L1, L2, L3	3(a), 3(b), 3(c), 4(a), 4(b), 4(c)	12
CO3 -Able to examine various Data Link layer design issues and Data Link protocols	L1, L2, L3	5(a), 5(b), 5(c), 6(a), 6(b), 6(c), 7(a), 7(b), 7(c)	18
CO4 -Able to compare and select appropriate routing algorithms for a network	L1, L2, L3	8(a), 8(b), 8(c)	6
CO5 -Able to examine the important aspects and functions of network layer, transport layer and application layer in internetworking	L1, L2, L3	9(a), 9(b), 9(c), 10(a), 10(b)	10
CO6 -Able to analyze different issues associated with data security using cryptography in network communication	L2	10(c)	2

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

- Q1.** Explain computer network and its uses. 2
- Q2.** Differentiate connection-oriented and connectionless services. List the five service primitives used for implementing a simple connection-oriented service. 2
- (c) A collection of five routers is to be connected in a point-to-point subnet. Between each pair of routers, the designers may put a high-speed line, a medium-speed line, a low-speed line, or no line. If it takes 100 ms of computer time to generate and inspect each topology, how long will it take to inspect all of them? 2

- Define network topology. Discuss various types of networks topologies in computer network. 2
- Compare OSI model with TCP/IP model. 2
- Briefly explain Wireless LANs: 802.11. 2
- (a) What is the definition and formula of Fourier series? Justify "limiting the bandwidth limits the data rate" 2
- Define Bandwidth of a transmission medium. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 15 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth. - 6.00 2
- (c) If a binary signal is sent over a 4-kHz channel whose SNR is 20dB, what is the maximum achievable data rate? 2
- Briefly explain about the Guided transmission Medias in computer networks? 2
- (b) Differentiate between circuit switching and packet switching? 2
- (c) What signal-to-noise ratio is needed to put a T₁ carrier on a 50 kHz line? 2
- What is the need of Flow control? Explain the common approaches for flow control in data link layer. 2
- (a) i. The following data fragment occurs in the middle of a data stream for which the byte stuffing algorithm is used: A B ESC C ESC FLAG D. What is the output after byte stuffing? 2
- ii. A bit string, 0111011110111110, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing? 2
- A bit stream 10101010 is transmitted using the standard CRC method. The generator polynomial is x^3+x^2+1 . Show the actual bit string transmitted. Suppose the second bit from the left is inverted during transmission. Show that this error is detected at the receiver's end. 2
- 8 bits messages are transmitted using a Hamming code. Show the bit pattern transmitted for the message 11000010. 2

- Describe sliding window protocol using Selective repeat. 2
- Station A needs to send a message consisting of 8 packets to Station B using a sliding window (Widow size 3) and Go-Back-N error control strategy. All packets are ready and immediately available for transmission. If every 6th packet that A transmit gets lost (but no ACKs from B ever get lost), then what is the number of packets that A will transmit for sending the message to B. 2
7. Explain how ALOHA solves the problem of Channel allocation. 2
- Describe Carrier Sense Multiple Access (CSMA) protocol. 2
- (c) A group of N stations share a 112-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on an average of once every 100 sec, even if the previous one has not yet been sent. What is the maximum value of N? 2
- Sketch the Manchester encoding for the bit stream: 1011010101. 2
- Differentiate between nonadaptive and adaptive routing Algorithm. What is optimality principle? 2
- Explain the basic concept of flooding and its use. 2
- Calculate the range of host addresses in IPv4 Class B and Class C formats. 2
- (b) A network on the Internet has a subnet mask of 255.255.255.0. Calculate up to how many Ethernets it can accommodate. What is the maximum number of hosts it can handle? 2
- Explain DHCP. 2
- Define UDP and discuss the different fields of the format of a used datagram. 2
- Describe importance of DNS in application layer. 2
- Explain with neat diagram, how communication takes place between sender and receiver in symmetric key cryptography. 2

End of Questions

What is the output of following python code?
def func():

2

8. (a) What is recursion? What are the different parts of a recursive function?
(b) Write a python program to find the gcd of two numbers, using recursion only.
(c) Write a recursive function in python to search an element of a list using binary search technique.

9. (a) Explain three different access modes for opening the file in python along with examples.
(b) Write a python program to copy the contents of File1 by reading it, into File2 by creating it and handle the error if either File1 doesn't exist.
(c) Write the type of error that will occur when following operations are performed:
 (i) m=Input('Enter value') (ii) 2+'5'
 (ii) int('Hello') (iv)28/(14-5-4-3-2)

10. (a) Define a class Person with following data attributes: name, date of birth, and address. Moreover, you need to use `__init__` for initialization of data members. Farther, explain the use of the `__init__` method.
(b) Define a class Rectangle. The class should contain sides: length and breadth of the rectangle as data members. It should support following methods:
 i. `__init__` for initialization of data members.
 ii. `setLength` for updating the length of the rectangle.
 iii. `setBreadth` for updating the length of the rectangle.
 iv. `area` for finding the area of the rectangle.
 v. `perimeter` for finding the perimeter of the rectangle.
(c) What is operator overloading? Explain how the + operator is overloaded in python with an example.

**END SEMESTER EXAMINATION, JANUARY-2023
PROGRAMMING IN PYTHON (CSE 3142)**

Programme: B.Tech (CSE)
Full Marks: 60

Semester: 5th
Time: 3 Hours

Subject/Course Learning Outcome	*Taxonomy Level	Ques. Nos.	Marks
Understand the basic programming syntax, semantics and building blocks of python	L1	1(a), 2(a, b), 3(a), 4(a), 8(a)	12
Develop python applications using the programming constructs like control structures, functions and strings	L3	1(c), 3(b), 5(a), 5(b), 8(b)	10
Analyze, debug and test the programs and correctly predict their output	L2, L4	1(b), 2(c), 3(c), 4(b, c), 5(c)	12
Illustrate the process of structuring the data using lists, sets, tuples and dictionaries	L2, L3	6(a, c), 7(a, b, c)	10
Solve the real life problems using object oriented concepts, modular approaches, files and exception handling	L3	9(a, b, c), 10(a, b, c)	12
Design application using sorting, searching and the concept of stack, queues, linked lists and trees	L3	6(b), 8(c)	4

*Bloom's taxonomy levels: Knowledge (L1), Comprehension (L2), Application (L3), Analysis (L4), Evaluation (L5), Creation (L6)

Answer all questions. Each question carries equal mark.

1. (a) Differentiate between the below-mentioned operators in python.
i. 'and' and '&' ii. 'or' and '|'
(b) Write a python program to swap two integers without using arithmetic operators and temporary variable.
(c) What does the following python program print?
`answer = ((not (9 == 8)) and ((7 + 1) != 8)) or (6 < 4.5)
print(answer)` 2

2. (a) Differentiate between "for" loop and "while" loop using appropriate examples. 2

(b) What is "conditional expression" in python? Write a 2
"conditional expression" for the following python code.
if (num % 2 == 0):
 print("Even Number")
else:

 print("Odd Number")

What is the output of the following python code?

number = 123456

a, b = 0, 0

while(number > 0):

 digit = number % 10

 if (digit % 2 == 0):

 a += digit

 else:

 b += digit

 number /= 10

print(a, b)

3. (a) What does a function return by default in python? 2
Write a function which returns area of a circle.

(b) Write a python function which takes co-ordinates of 2
three points as input and returns true if points are
collinear otherwise returns false.

(c) def fun(a=0,b=1): 2
 return a**b + b**a

What will be the output for each call made below?

 a) fun(2, a=3)

 b) fun(b=3, a=2)

 c) fun()

fun(1,2)

4. (a) What is difference between step and next command of 2
Python debugger pdb?

(b) Find the logical error in following function which 2
returns the factorial value of an integer n.

def factorial(n): 10

 fact=1

 for i in range(1,n):

 fact=fact*i

 return fact

(c) What is the output of following python code? 2

x = 10

def f():

 x = 20

def g():

 nonlocal x

```
x = 30
print(x)
print(x)
g()
f()
print(x)
```

5. (a) Differentiate between split () and partition () function in 2
string.

(b) Write python code to read a sentence as an input 2
parameter and count the number of words in the
sentence.

For Example: if the sentence is "Programming in
python" then the number of words is 3.

(c) What is the output of following python code? 2

```
import re
string1 = "Regular expression defines a pattern"
r1 = re.findall(r"^\w+", string1)
print(r1)
print((re.split(r'\s', string1)))
```

6. (a) Write a lambda expression to compute average marks 2
obtained by a student in three subjects, say S1, S2,
and S3.

(b) Write a python script to find the kth smallest element 2
of a list using Bubble Sort technique.

(c) (i) What is the output of following python code? 2
n1, n2 = 6, 9
commonFactors = [i for i in range(1, min(n1+1, n2+1))
if (n1 % i == 0 and n2 % i == 0)]
print(commonFactors)

ii. What is the output of following python code?

```
a = [1, 2, 3, 4, 5]
c = [x**2 + y**2 for x, y in zip(a, a)]
print(c)
```

7. (a) State the difference between set and dictionary with 2
suitable examples.

(b) Write a function that takes a number as an input 2
parameter and returns the correspond text in words,
for example, on input 452, the function should return
'Four Five Two'.