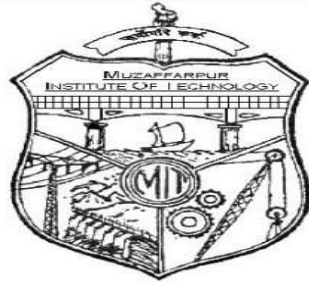# MUZAFFARPUR INSTITUTE OF TECHNOLOGY
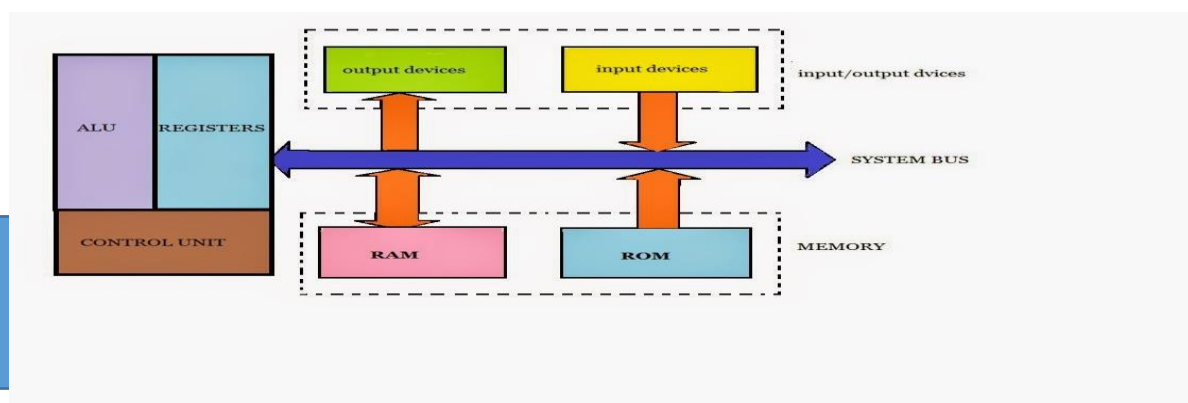

COURSE FILE

OF

MICROPROCESSOR AND ITS APPLICATIONS

(EE031411)

Faculty Name:

MR. ANKIT KUMAR SINGH

Asst. Prof. , DEPARTMENT OF ELECTRICAL ENGINEERING

CONTENTS

1. Cover Page & Content
2. Vision of the Department
3. Mission of the department
4. PEO's and PO's
5. Course objectives &course outcomes (CO's)
6. Mapping of PO's with CO's
7. Course Syllabus and GATE Syllabus
8. Time table
9. Student list
10. Course Handout
11. Lecture Plan
12. Assignment sheets
13. Sessional Question Papers
14. Old End Semester Exam (Final Exam) Question Papers
15. Results
16. Result Analysis
17. Quality Measurement Sheets
    a) Course End Survey
    b) Teaching Evaluation

Electrical Engineering Department

Vision of The Department

To produce cutting edge Electrical Engineers, innovators, researchers, and entrepreneurs with high human values to serve society, industry, nation and the world.
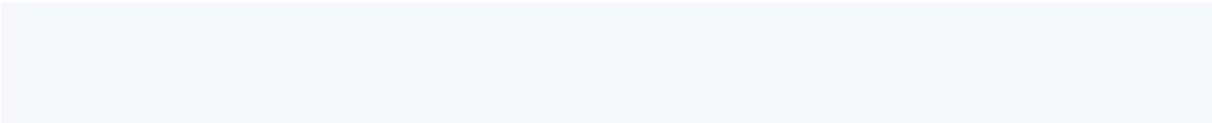
Vision of The Department

M1. To create state-of-the-art facilities for under-graduate, post- graduate and R&D work.

M2. To cater the needs of society with recent technologies, innovative ideas and inculcate ethical responsibilities.

M3. To develop strong collaborative links with premier industries, institutions and the government agencies.

Program Educational Objectives (PEOs) of Electrical Engineering Department

PEO 1. Students will be able to engage in life-long learning and research including supportive and responsible roles on multi-disciplinary tasks.

PEO 2. Students will acquire, use and develop skills as required for effective professional and societal practices and leadership quality.

PEO 3. Students will be able to create a new dimension of innovation and entrepreneurship.

Program Outcomes (POs) based on Program Educational Objectives (PEOs) of Electrical Engineering Department:

PO 1. Students will be able to apply knowledge of applied mathematics & science in electrical engineering problems.

PO 2. Students will be able to identify, formulate and solve society and industries related problems.

PO 3. Students will be able to apply knowledge to design a system, component or process to meet desired needs within realistic constraints.

PO 4. Students will be able to conduct laboratory experiments and to critically analyze and interpret experimental data.

PO 5. Students will be able to use the recent techniques, skills, and modern tools necessary for engineering practices.

PO 6. Students will be able to understand the impact of engineering problems, solutions in a global and societal context.

PO 7. Students will be able to demonstrate professional and ethical responsibilities.

PO 8. Students will be able to apply leadership quality to work with team in the area of electrical engineering towards the solution of multi-disciplinary tasks.

PO 9. Students will be able to communicate effectively through verbally, technical writing, reports and presentation.

PO 10. Students will be able to develop confidence for self-education and ability to engage in life-long learning.

SYLLABUS

MICRO PROCESSOR AND ITS APPLICATION

Course Code- 031611

Intel 8085

1. Introduction: CPU, Register, memory, Buses, Memory addressing capacity of a CPU.
    Lecture: 3
2. CPU Architecture, Pin configuration, Instructions, Addressing modes, Instruction word size, Languages. **Lecture: 4**
3. Timing Diagram: Read cycle, write cycle, fetch cycle, Memory read, Memory write, I/O cycle.
    Lecture: 3
4. Programming: Simple programming: 8-bit addition &subtraction, 16-bit addition, Delay subroutine using register, finding lowest & highest no. in data array. **Lecture: 5**
5. Data transfer schemes, I/O port. **Lecture: 6**
6. 8255, 8251, 8253, 8257chips, pin diagram, control word, operating modes.
    Lecture: 6
7. Interfacing to ADC, Analog multiplexer, simple & hold. **Lecture: 4**

Intel 8086

8. Architecture: BIU & Execution unit, pin diagram, function of different modes, registers
    Lecture: 4
9. Addressing Modes, Instruction **Lecture: 4**
10. Programming **Lecture: 3**

Gate Syllabus

8085Microprocessor: Architecture, Programming and Interfacing.

Course Outcomes and Objectives

Scope and Objectives of the Course

This course deals with the systematic study of the Architecture and programming issues of 8 bit 8085-microprocessor and interfacing with other peripheral ICs and co-processor. In addition, a 16-bit microprocessors and other chips (8255, 8251, 8253 and 8257) are introduced. The aim of this course is to give the students basic knowledge of the microprocessors (8085 and 8086) needed to develop the systems using it.

The course outcomes are:

1. Understand the architecture of 8085 and 8086.
2. Impart the knowledge about the instruction set.
3. Understand the basic idea about the data transfer schemes and its applications.
4. Develop skill in simple program writing for 8085 & 8086 and applications.

Course Outcomes:

At the end of this course, students will be able to

CO1: Understand the basic architecture of 8085 and 8086.

CO2: Impart the knowledge about the instruction set.

CO3: Understand the basic idea about the data transfer schemes and its applications

CO4: Develop skill in simple program writing for INTEL 8085 and INTEL 8086.

Topics	No of lectures	Weightage
Evolution of Microprocessor, Evolution of Digital Computers, CPU (Central Processing Unit), Register, Types of Registers, Memory, Types of Memory, Address Bus, Data bus, control bus Memory addressing capacity of a CPU. Applications of Microprocessor	3	6%
CPU Architecture, ALU, Timing and control unit, Registers, PIN Configurations, Instructions, Addressing Modes, Instruction Word Size, Languages, opcode and operands	4	12%
Instruction cycle, fetch operation, execute operation, machine cycle and state, instruction and data flow, Timing Diagram for Opcode Fetch Cycle, Memory Read, Memory Write, I/O Read, I/O Write.	3	16%
Instructions Set of 8085, stack, subroutine, assembly language, Simple Programming: 8 bit Addition and Subtraction, 16 bit Addition, Delay Subroutine using Registers, Finding lowest and Highest no. in a data array.	5	20%
Basic Interfacing Concepts, Memory Interfacing, Interfacing output Displays, Interfacing Input Devices, Data Transfer Schemes, Interrupts of 8085	6	12%
Programmable Peripheral Interface (PPI), Introduction to 8255, 8251, 8253, 8257 Chips, Pin Diagram, Control Word, Operating Modes, Instruction	6	11%
Analog to Digital Converter, Analog Multiplexer, Sample and Hold Circuit, Interfacing to ADC	4	5%
Introduction to INTEL 8086 Microprocessor, Architecture, Bus Interface Unit (BIU), Execution Unit (EU), PIN Diagram, Function of Different Modes, Registers, Addressing Modes, Interrupts	5	8%
Instruction Sets of 8086, Simple Programming to 8086: Largest no. in a data array, Smallest no. in data array	4	10%

Mapping of PO's with CO's

Sr. No.	Course Outcome	PO
1.	CO1: Understand the basic architecture of 8085 and 8086.	PO2, PO3
2.	CO2: Impart the knowledge about the instruction set.	PO5
3.	CO3: Understand the basic idea about the data transfer schemes and its applications.	PO5, PO6
4.	CO4: Develop skill in simple program writing for INTEL 8085 and INTEL 8086.	PO2, PO3, PO10

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1: Understand the basic architecture of 8085 and 8086.		✓	✓							
CO2: Impart the knowledge about the instruction set.					✓					
CO3: Understand the basic idea about the data transfer schemes and its applications					✓	✓				
CO4: Develop skill in simple program writing for INTEL 8085 and INTEL 8086.		✓	✓							✓

Time Table

DAY/TIME	10:00-10:50	10:50-11:40	11:40-12:30	12:30-1:20	1:20-1:50	1:50-2:40	2:40-3:30	3:30-4:20
MONDAY				Micro. Proc.	L U N C H			
TUESDAY	Micro. Proc.					Microprocessor and its application lab		
WEDNESDAY		Micro. Proc.						
THURSDAY						Microprocessor and its application lab		
FRIDAY								
SATURDAY								

List of Students

S. NO	Roll No	Name of Students
1	15E01	PRASOON BALA
2	15E02	SUMI SINGH
3	15E03	SURYA SINGH
4	15E04	BINDIA RANI
5	15E06	MADHU KUMARI
6	15E07	VIVEK KUMAR
7	15E08	KAJAL RAJ
8	15E09	ANKITA SINDURIYA
9	15E10	NIRAJ KUMAR
10	15E11	SANDEEP SITESH
11	15E12	NISHANT GUPTA
12	15E13	PRAKASH KUMAR
13	15E14	PRADEEP KUMAR
14	15E15	RAVI RANJAN
15	15E16	RAVI SHANKAR SAH
16	15E17	ALOK KUMAR
17	15E18	RAVI KANT SINGH
18	15E19	OM PRAKASH CHAUDHARY
19	15E20	AMAN KUMAR
20	15E21	MD SARFARAJ AHMAD
21	15E22	AZIM ANSARI
22	15E23	NAYAN PRIYA
23	15E24	JYOTI KUMARI
24	15E25	SUJEET KUMAR
25	15E26	ATUL SHAKTI
26	15E27	RAHUL KUMAR
27	15E28	ABHISHEK KISHORE
28	15E29	RUHI KUMARI
29	15E30	RAJEEV KUMAR CHOUDHARY
30	15E31	SAURAV KUMAR
31	15E32	KISHAN KUMAR
32	15E33	MANISH KUMAR
33	15E34	AMIT KUMAR
34	15E35	HAPPY KUMAR
35	15E36	RAVI RANJAN
36	15E37	SHASHANK SUDHANSHU
37	15E38	NEHA GUPTA
38	15E39	SWETA JAMUAR
39	15E40	SURUCHI KUMARI
40	15E41	SOURAV SRIKANT
41	15E42	TAHA ALAM

42	15E43	SUMIT KUMARI
43	15E44	NIKET NIRAJ
44	15E45	MAYANK KASHYAP
45	15E46	SATISH KUMAR
46	15E47	ASHUTOSH SHIVAM
47	15E48	PAVAN KUMAR
48	15E49	MEDHA CHAUDHARY
49	15E50	NAGESHWAR SHARMA
50	15E51	PRIYANKA SUMAN
51	15E52	PALLAVI KUMARI
52	15E54	SHASHI RANJAN
53	15E55	DEO
54	15E56	KRISHNA KUMAR
55	15E57	RAJLAXMI KUMARI
56	15E59	AJIT KUMAR
57	15E61	NAYAN Kr NAYAN
58	15E62	SUDEEP KUMAR
59	15E63	RAJU KUMAR
60	15E64	PREM N CHAUDHARY
61	15E65	PRIYANKA KUMARI
62	15E66	DEEPAK KUMAR SINGH
63	16(LE)E01	SHAFAQUE NAZREEN
64	16(LE)E02	PAVAN KUMAR
65	16(LE)E03	PRIYANKA KUMARI
66	16(LE)E04	ROHAN RAJ
67	16(LE)E06	SHEKHAR KUMAR
68	16(LE)E07	MD MOIN
69	16(LE)E09	PINTU KUMAR
70	16(LE)E10	GAUTAM BHARTI

Textbooks

TB1: 'Fundamentals of Microprocessors and microcontrollers' by B. Ram, Eighth Revised Edition,

Dhanpat Rai Publications.

TB2: 'Advanced Microprocessor and Interfacing' by B. Ram, Mc Graw Hill Education.

Reference Books

RB1: 'Microprocessor & Interfacing' by D.V hall, Tata MacGraw Hill

RB2: 'Microprocessor Architecture' by R.S Gaonkar, Penram International Publishing (India) PVT.

LTD.

RB3: 'Microprocessor with Application in process control' by S.I Ahson, Tata MacGraw Hill

RB4: 'The Intel Microprocessor Architecture, Programming & Interfacing' by B.Brey, 8th Edison,
PEARSON Publication

Lecture Number	Topics	Text Book / Reference Book / Other reading material
1-3	**Introduction**	TB1, RB4
	Evolution of Microprocessor, CPU (Central Processing Unit), Register, Types of Registers, Memory, Types of Memory, Buses, Memory addressing capacity of a CPU. Applications of Microprocessor	
4-7	**Microprocessor Architecture**	TB1, RB2, RB4
	CPU Architecture, PIN Configurations, Instructions, Addressing Modes, Instruction Word Size, Languages	
8-10	**Timing Diagram**	TB1, RB1, RB2
	Timing Diagram for Opcode Fetch Cycle, Memory Read, Memory Write, I/O Read, I/O Write.	
11-15	**Programming**	TB1, RB4, TB2
	Instructions Set of 8085, Simple Programming: 8 bit Addition and Subtraction, 16 bit Addition, Delay Subroutine using Registers, Finding lowest and Highest no. in a data array.	
16-20	**Peripheral Devices and their Interfacing**	TB1, TB2, RB4
	Basic Interfacing Concepts, Memory Interfacing, Interfacing output Displays, Interfacing Input Devices, Data Transfer Schemes, Interrupts of 8085	
21-26	**I/O Ports**	TB1, RB3, RB2
	Programmable Peripheral Interface (PPI), Introduction to 8255, 8251, 8253, 8257 Chips, Pin Diagram, Control Word, Operating Modes, Instruction	
27-30	**Microprocessor-Based Data Acquisition System**	TB1, RB2, RB4
	Analog to Digital Converter, Analog Multiplexer, Sample and Hold Circuit, Interfacing to ADC	
31-35	**INTEL 8086**	TB1, RB4
	Introduction to INTEL 8086 Microprocessor, Architecture, Bus Interface Unit (BIU), Execution Unit (EU), PIN Diagram, Function of Different Modes, Registers, Addressing Modes	
36-40	**Programming the 8086**	TB1, RB4
	Instruction Sets of 8086, Simple Programming to 8086	

Students are advised to go through the NPTEL lectures available on its official website (https://onlinecourses.nptel.ac.in/noc18_ec03/preview) and also on you tube (https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0).

ASSINGMENT 1

1. Discuss the functional block diagram of INTEL 8085 Microprocessor.
2. Discuss the function of ALU of 8085.
3. Explain the Requirement of Program counter, stack pointer, and status flags in the architecture of INTEL 8085 microprocessor.
4. Draw and explain the timing diagram for the instruction of MVI r, data.
5. Two machine codes—0011 1110 (3EH) and 0011 0010 (32H) are stored in memory location 2000H and 2001H, respectively. The first machine code 3EH represents the opcode to load a data byte in the accumulator. Illustrate the bus timings as these machine codes are executed. Calculate the time required to execute the opcode fetch and the memory read cycles and the entire instruction cycle if the clock frequency is 2MHz.

ASSINGMENT 2

1. Discuss subroutine and its importance.
2. What are the different addressing modes? Explain.
3. What will be the output of the program at PORT 1 given below? Give the stepwise explanation of given program. Also calculate the execution time if the microprocessor is operating at 2MHz.

MVI B, 91H
MVI C, A8H
MOV A, B
ORA C
OUT PORT 1
HLT

4. Write a program to add two 16-bit numbers stored at location 2000H and 2002H. Save the result at 8000H.
5. Write a program to count continuously in hexadecimal from FFH to 00H in a system with a 0.5micro sc. Clock period. Use register C to set up a one millisecond delay between each count and display the numbers at one of the output ports.

ASSINGMENT 3

1. What is programmable interrupt controller and Direct Memory Access? Discuss primary features of programmable interrupt controller.
2. How many operating modes does 8086 have? Discuss them in brief.
3. Write an 8086 assembly language program to find the sum of a series of 16 bit no. whose sum is of 16 bits.
4. Discuss the interrupt system of Intel 8086. What is interrupt pointer?

Question Paper

END SEMESTER POWER SYSTEM DESIGN PAPER- 2017

akubihar.com   **Code : 031611**

B.Tech. 6th Semester Exam., 2016

MICROPROCESSOR AND ITS APPLICATION

Time : 3 hours   *Full Marks* : 70

Instructions :

(i) *The marks are indicated in the right-hand margin.*

(ii) *There are NINE questions in this paper.*

(iii) *Attempt FIVE questions in all.*

(iv) *Question No. 1 is compulsory.*   akubihar.com

1. Choose the correct alternative (any seven) :

$2 \times 7 = 14$

(a) Intel 8085 microprocessor has

(i) 8 address bus

(ii) 16 address bus

(iii) 32 address bus

(iv) 64 address bus

(b) Intel 8085 can address

(i) 1k memory location

(ii) 2k memory locations

(iii) 16k memory locations

(iv) 64k memory locations

akubihar.com   **(2)**

(c) Intel 8085 has

(i) 10 status flags

(ii) 5 status flags

(iii) 2 status flags

(iv) 6 status flags

akubihar.com

(d) Program counter is a/an

(i) 8-bit register

(ii) 16-bit register

(iii) 32-bit register

(iv) 10-bit register

(e) STA 8050 is having

(i) 4 machine cycles

(ii) 3 machine cycles

(iii) 2 machine cycles

(iv) 1 machine cycle

(f) 8255 is a

(i) 24 pin IC   akubihar.com

(ii) 32 pin IC

(iii) 40 pin IC

(iv) 16 pin IC

5.

(g) 8257 is a

   (i) programmable peripheral interface

   (ii) programmable DNA controller

   (iii) programmable communication interface

   (iv) programmable interval timer

(h) 8253 is a

   (i) 24 pin IC

   (ii) 40 pin IC

   (iii) 16 pin IC

   (iv) 32 pin IC

akubihar.com

(i) 8255 has

   (i) one mode of operation

   (ii) two modes of operation

   (iii) three modes of operation

   (iv) four modes of operation

(j) Intel 8086 is a/an

   (i) 8-bit microprocessor

   (ii) 16-bit microprocessor

   (iii) 32-bit microprocessor

   (iv) 64-bit microprocessor

---

2. (a) Discuss the functions of the following pins of 8085 microprocessor :   7

   HLDA, $\overline{\text{INTA}}$, RESET IN, (x_1, x_2), SOD

  (b) Discuss the register organization of 8085 microprocessor.   7

3. (a) Describe the operations performed by the following instructions of 8085 microprocessor :   8

   ANAM,   INX.B,   RAR,   RNC,   PUSH B, XTHL

  (b) Draw and explain the timing diagram of MVIB-07H.   akubihar.com   6

4. (a) Write an ALP to add two 8-bit numbers and sum is 16-bit in 8085.   6

  (b) Write an ALP to find 2's complement of a 16-bit number of 8085 microprocessor.   8

5. Write an ALP to largest number in a data array.   14

6. (a) Discuss the operating modes of 8255.   7

  (b) Write a control word for the following configuration :   7

   Port A-output;   Mode of port A-Mode 1
   Port B-output;   Mode of Port B-Mode 0
   PC lower-output;   Cupper-output

(5)

7. (a) Discuss the operating principle of 8253.   7

    (b) Discuss the pin description of 8251.   7

8. (a) Explain the functions of the following pins of 8086 microprocessor :   7

      A18/S5, TEST, READY, RESET, QSI (INTA)

    (b) Discuss the different segments and segment registers of 8086 microprocessor.   7

9. (a) Write the operations performed by the following instructions :   7

      IMUL CX, 8 TOBSB, DAA, CMPAL, 58H, ANDCL, 06H

    (b) Discuss the addressing modes of 8086 microprocessor.   7

★★★

RESULT

S. NO	Roll No	Name of Students	MARKS (30)
1	15E01	PRASOON BALA	26
2	15E02	SUMI SINGH	29
3	15E03	SURYA SINGH	27
4	15E04	BINDIA RANI	29
5	15E06	MADHU KUMARI	20
6	15E07	VIVEK KUMAR	21
7	15E08	KAJAL RAJ	29
8	15E09	ANKITA SINDURIYA	30
9	15E10	NIRAJ KUMAR	27
10	15E11	SANDEEP SITESH	27
11	15E12	NISHANT GUPTA	24
12	15E13	PRAKASH KUMAR	26
13	15E14	PRADEEP KUMAR	27
14	15E15	RAVI RANJAN	24
15	15E16	RAVI SHANKAR SAH	23
16	15E17	ALOK KUMAR	30
17	15E18	RAVI KANT SINGH	21
18	15E19	OM PRAKASH CHAUDHARY	26
19	15E20	AMAN KUMAR	27
20	15E21	MD SARFARAJ AHMAD	25
21	15E22	AZIM ANSARI	27
22	15E23	NAYAN PRIYA	30
23	15E24	JYOTI KUMARI	25
24	15E25	SUJEET KUMAR	26
25	15E26	ATUL SHAKTI	27
26	15E27	RAHUL KUMAR	28
27	15E28	ABHISHEK KISHORE	26
28	15E29	RUHI KUMARI	26
29	15E30	RAJEEV KUMAR CHOUDHARY	27
30	15E31	SAURAV KUMAR	27
31	15E32	KISHAN KUMAR	24
32	15E33	MANISH KUMAR	26
33	15E34	AMIT KUMAR	26
34	15E35	HAPPY KUMAR	25
35	15E36	RAVI RANJAN	25
36	15E37	SHASHANK SUDHANSHU	23
37	15E38	NEHA GUPTA	27
38	15E39	SWETA JAMUAR	29
39	15E40	SURUCHI KUMARI	27
40	15E41	SOURAV SRIKANT	24
41	15E42	TAHA ALAM	28
43	15E44	NIKET NIRAJ	30

44	15E45	MAYANK KASHYAP	26
45	15E46	SATISH KUMAR	26
46	15E47	ASHUTOSH SHIVAM	20
47	15E48	PAVAN KUMAR	23
48	15E49	MEDHA CHAUDHARY	27
49	15E50	NAGESHWAR SHARMA	25
50	15E51	PRIYANKA SUMAN	27
51	15E52	PALLAVI KUMARI	30
52	15E54	SHASHI RANJAN	20
53	15E55	DEO	24
54	15E56	KRISHNA KUMAR	21
55	15E57	RAJLAXMI KUMARI	25
56	15E59	AJIT KUMAR	26
57	15E61	NAYAN Kr NAYAN	27
58	15E62	SUDEEP KUMAR	23
59	15E63	RAJU KUMAR	26
60	15E64	PREM N CHAUDHARY	Abs
61	15E65	PRIYANKA KUMARI	28
62	15E66	DEEPAK KUMAR SINGH	28
63	16(LE)E01	SHAFAQUE NAZREEN	27
64	16(LE)E02	PAVAN KUMAR	22
65	16(LE)E03	PRIYANKA KUMARI	28
66	16(LE)E04	ROHAN RAJ	28
67	16(LE)E06	SHEKHAR KUMAR	22
68	16(LE)E07	MD MOIN	19
69	16(LE)E09	PINTU KUMAR	28
70	16(LE)E10	GAUTAM BHARTI	26

RESULT ANALYSIS

THEORY

Bar chart titled "THEORY" showing NUMBER OF STUDENTS.
Legend: <60%, 60-70%, 70-80%, 80-90%, 90-100%
Values: 1, 4, 9, 24, 31
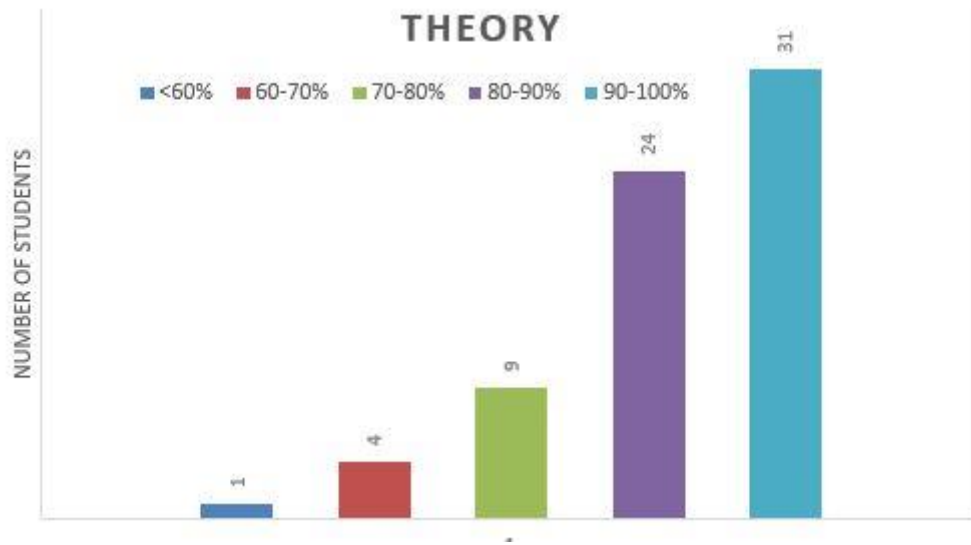
Quality Measurement Sheets

a. Course End Survey

ACADEMIC YEAR: 2017-2018	SEM: VI	DATE:
COURSE: MICROPROCESSOR AND ITS APPLICATION	CLASS: EE	FACULTY: MR. ANKIT KUMAR SINGH

Please evaluate on the following scale:

Excellent(E)	Good(G)	Average(A)	Poor(P)	No Comment(NC)
5	4	3	2	1

SNO	QUESTIONAIRE	E 5	G 4	A 3	P 2	NC 1	Avg %
GENERAL OBJECTIVES:							
1	Did the course achieve its stated objectives?						
2	Have you acquired the stated skills?						
3	Whether the syllabus content is adequate to achieve the objectives?						
4	Whether the instructor has helped you in acquiring the stated skills?						
5	Whether the instructor has given real life applications of the course?						
6	Whether tests, assignments, projects and grading were fair?						
7	The instructional approach (es) used was (were) appropriate to the course.						
8	The instructor motivated me to do my best work.						
9	I gave my best effort in this course						
10	To what extent you feel the course outcomes have been achieved.						
Please provide written comments:							

a) What was the most effective part of this course?

b) What are your suggestions, if any, for changes that would improve this course?

c) Given all that you learned as a result of this course, what do you consider to be most important?

d) Do you have any additional comments or clarifications to make regarding your responses to any particular survey item?

e) Do you have any additional comments or suggestions that go beyond issues addressed on this survey?

MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR

Department of Electrical Engineering

Course Assessment

ACADEMIC YEAR: 2017-2018	SEM: VI	DATE:
COURSE: MICROPROCESSOR AND ITS APPLICATION	CLASS: EE	FACULTY: ANKIT KUMAR SINGH

Assessment	Criteria Used	Attainment Level			Remarks
Direct (d)	Theory				
	External Marks	___			
	Internal Marks (Theory)				
	Assignments				
	Tutorials				
Indirect (id)	Course End Survey				
Theory: Course Assessment (0.6 × d+ 0.4 × id)					