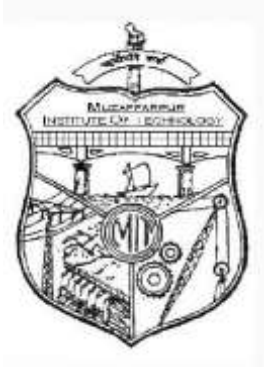
MIT MUZAFFARPUR

COURSE FILE

OF

____Instrumentation And Measurement_____

(Ins&Msr 021619)



FACULTY NAME

Niteesh Kumar Dubey

Assistant Professor

DEPARTMENT

OF

Mechanical Engineering

Muzaffarpur Institute of Technology, Muzaffarpur

Department of Mechanical Engineering

Vision

- To strengthen the region through imparting superior quality technical education and research; which enables the fulfillment of industrial challenge and establish itself as a Centre of Excellence in the field of Mechanical Engineering.

Mission

- To build an academic environment of teaching and lifelong learning for students to make them competitive in context with advance technological, economical and ecological changes.

- To enable the students to enhance their technical skills and communications through research, innovation and consultancy projects.

- To share and explore the accomplishments through didactic, enlightenment, R & D programs with technical institution in India and abroad.

Program Educational Objectives

- Graduates will spread and enhance their technical capability and proficiency through vital domain of economical, environmental and social concerns affiliated with the mankind and industry.

- Graduates will able to work professionally with modern methods in the area of Thermal, Mechanical System Design, Manufacturing, Measurement, Quality control and other interdisciplinary fields of concerns.

- Graduates will practice Mechanical engineering in sensible, flexible and ethical manner to benefit the society, industry and nation toward the rapidly changing global technical standards.

- Graduates will serve as ambassadors for engineering by their knowledge, creativity, imagination and innovation and set new extremes in their profession through lifelong learning.

Mechanical Engineering Student Outcomes

Students who complete the B.E. degree in ME will be able to:

1. An ability to apply the knowledge of mathematics, basic sciences and engineering concepts to solve the complex engineering problems.
2. The ability to conduct experiments and to critically analyze and interpret the experimental data to reach at substantial outcomes.
3. An ability to design systems, components, or processes to meet appropriate needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. An ability to identify, formulates, and solves the complex engineering problems.
5. An ability to function on multi-disciplinary teams that leads the multi-disciplinary projects.
6. An understanding of professional and ethical responsibility.
7. An ability to communicate effectively with written, oral, and visual means.
8. An ability to understand the impact of engineering solutions in a global, environmental, economical and societal context.
9. An ability to recognize the need to engage in life-long learning.
10. An ability to attain knowledge of contemporary issues.
11. An ability to use the techniques, skills, and modern tools necessary for Mechanical engineering practice.
12. Possess ability to estimate costs, estimate quantities and evaluate materials for design and manufacturing purposes.

Instrumentation and Measurement

Vision

Excellence in Instrumentation and Measurement education through innovative practice and team work.

Mission

- To provide quality education environment that inspire the students to realize their potential.
- To inculcate research and Industrial collaboration in order to enhance sustainable development of global community.
- To impart the technical knowledge by which they develop the ability to conduct investigations of complex problem using research literature and be able to analyze the problem to provide valid conclusion.

Short Term Goals

- Arrange the Industrial visit.
- Develop the proper lab for practical visual of the subject.
- To start the Research Nodal Centre.

Long Term Goals

- To develop Center of Excellence in collaboration with Industry.
- To setup R&D Laboratory in collaboration with Industries.

Course Objective

- Introduce students to the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements.
- Make the student able for rating instrument devices including dynamic range, resolution, accuracy and precision.
- Provide students with opportunities to develop basic skills in the design of electronic equipment.

Course Outcomes

After completing the course, student will be able to

CO1 - Identify electronics/ electrical instruments, their use, peculiar errors associated with the instruments and how to minimize such errors.

CO2 - Understand working principles in the measurement of field quantities.

CO3 - Explain the industrial and laboratory applications of such instruments.

CO4 - Service and maintain such instruments in case of damage or misuse

CO-PO MAPPING

	Course Outcome	PO
CO1	Identify electronics/ electrical instruments, their use, peculiar errors associated with the instruments and how to minimize such errors.	PO1, PO3, PO4, PO5
CO2	Understand working principles in the measurement of field quantities.	PO1, PO4, PO5
CO3	Explain the industrial and laboratory applications of such instruments.	PO3, PO6, PO11
CO4	Service and maintain such instruments in case of damage or misuse	PO4, PO6, PO11

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√		√	√	√							
CO2	√			√	√							
CO3			√			√					√	
CO4				√		√					√	

Institute Name	**MIT MUZAFFARPUR**		
Program Name	**B. Tech Mechanical**		
Course Code	Ins&Msr 021619		
Course Name	Instrumentation and Measurement		
Lecture / Tutorial (per week)	3/1	**Course Credits**	4
Course Coordinator Name	**Niteesh Kumar Dubey**		

Course Description

Instrumentation is a science which deals with measurement and control. The knowledge of instrumentation and its practical applications is of vital importance in the modern competitive industrial environment. The most important factor in achieving quality and reliability in service of any product is its dimensional control. Due to rapid development in the field of measurements and industrial instrumentation, the student has to know the basic fundamentals and know about mechanisms and assemblies the functioning of which must meet the stringent design requirement. Course deals with topics such as Principle of measurements, Errors, Accuracy, Units of measurements, Description of various types of transduction principles, Data acquisition systems.

Course Objective

- Introduce students to the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements.
- Make the student able for rating instrument devices including dynamic range, resolution, accuracy and precision.
- Provide students with opportunities to develop basic skills in the design of electronic equipment.

Course Outcomes After completing the course, student will be able to

CO1 - Identify electronics/ electrical instruments, their use, peculiar errors associated with the instruments and how to minimize such errors.
CO2 - Understand working principles in the measurement of field quantities.
CO3 - Explain the industrial and laboratory applications of such instruments.
CO4 - Service and maintain such instruments in case of damage or misuse.

Textbooks and Reference Books

TB1: Measurement and Instrumentation Principles by **Alan S. Morris,** Reza langar
RB1: Engineering Metrology and measurements by N.V.Raghavendra, L.Krishnamurthy
RB2: Measurement principal by Dominique placko

Course Plan

Lecture Number	Date of Lecture	Topics	Web Links for video lectures	Text Book / Reference Book / Other reading material	Page numbers of Text Book(s)
1-6		**Functional elements of a basic measuring system**		TB1	1-10
		Configuration of a measuring system, Methods for correction for interfering and modifying inputs.	**https://www.youtube.com/watch?v=3VW-yb5xUVY**	Self-prepared notes	
Tutorial - 1					
7-14		**Static characteristics like accuracy**		TB1	11-34
		Precision, error sensitivity etc. Dynamic characteristics terms, concepts Of mechanical loading, order of the systems, response of zero, first and second order systems to step, ramp And sinusoidal inputs, transfer function method.	**https://www.youtube.com/watch?v=Hlvbr5DCEfM**	Self-prepared notes	
Mid-Semester Exam (Syllabus covered from 1-14 lectures)					
15-18		**Classification of errors**		TB1	39-94
		Statistical analysis of experimental data.	**https://www.youtube.com/watch?v=Mdn2VbIACAU**	Self-prepared notes	
Tutorial – 2					

19-28		**Description of various types of transduction principles**		RB1	315-320
		Transducers based on variable resistance, variable induction, variable capacitance and piezo-electric effects, Displacement transducer.	**https://www.youtube.com/watch?v=1uPTyjxZzyo**	Self-prepared notes	
Tutorial – 3,					
29-34		**Microprocessor systems**		Self-Prepared Notes	
		Codes, Binary mathematics, Logic circuits.	**https://www.youtube.com/watch?v=-i3-Y-5qyho**		
Tutorial - 4					
35-38		**Data acquisition systems**		TB1	115-133
		Via-computers DAS hardware.	**https://www.youtube.com/watch?v=I_9Pwyxhe40**		
39-42		**Techniques for signal analysis.**		RB2	441-459

Evaluation Scheme:

Component 1	Mid Semester Exam	20
Component 2	Assignment Evaluation	10
Component 3**	End Term Examination**	70
	Total	**100**

****** The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

SYLLABUS

Topics	No of lectures	Weightage
Functional elements for the basic measuring system, configuration of a measuring system. Methods for correction for interfering and modifying inputs.	6	20%
Static characteristics like accuracy, Precision, error sensitivity etc. Dynamic characteristics terms, concepts Of mechanical loading, order of the systems, response of zero, first and second order systems to step, ramp And sinusoidal inputs, transfer function method.	8	20%
Classification of errors, Statistical analysis of experimental data.	4	15%
Description of various types of transduction principles, Transducers based on variable resistance, variable induction, variable capacitance and Piezo-electric effects, Displacement transducer.	10	10%
Microprocessor systems, Codes, Binary mathematics, Logic circuits.	6	10%
Data acquisition systems, Via-computers DAS hardware.	4	6%
Techniques for signal analysis**.**	4	15%

This Document is approved by:

Designation	Name	Signature
Course Coordinator	Niteesh Kumar Dubey	
H.O.D	Dr. Vikas Kumar	
Principal	Dr. Jagada Nand Jha	
Date		

Evaluation and Examination Blue Print:

Internal assessment is done through quiz tests, presentations, assignments and project work. Two sets of question papers are asked from each faculty and out of these two, without the knowledge of faculty, one question paper is chosen for the concerned examination. Examination rules and regulations are uploaded on the student's portal. Evaluation is a very transparent process and the answer sheets of sessional tests, internal

(From amongst the three sessional tests best of two are considered)

Syllabus

Instrumentation and Measurement

Course Code- 021619

1. **Functional elements of a basic measuring system,** configuration of a measuring system, Methods for correction for interfering and modifying inputs. **Lecture: 6**
2. **Static characteristics like accuracy**, precision, error sensitivity etc. Dynamic characteristics terms, Concepts of mechanical loading, order of the systems, Response of zero, First and second order systems to step, ramp and sinusoidal inputs, transfer function method.
   Lecture: 8
3. **Classification of errors** and statistical analysis of experimental data. **Lecture: 4**
4. **Description of various types of transduction principles**, transducers based on variable resistance, variable induction, variable capacitance and piezo-electric effects, Displacement transducer.
   Lecture: 10
5. **Microprocessor systems**, codes, Binary mathematics, Logic circuits. **Lecture: 6**
6. **Data acquisition systems**, via-computers DAS hardware. **Lecture: 4**
7. **Techniques for signal analysis. Lecture: 4**

GATE SYLLABUS

Instrumentation and Measurements

Measurements

SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, propagation of errors.

Sensors and Industrial Instrumentation

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement.

MUZAFFARPUR INSTITUTE OF TECHNOLOGY
B.Tech. 6 th (Sixth) Semester, Mechanical Engineering, (2015 Batch) TIME TABLE

6th Semester ME								ROOM NO-47
Day/ time	10:00-10:50	10:50-11:40	11:40-12:30	12:30-13:20	13:20-13:50	13:50-14:40	14:40-15:30	15:30-16:20
MON	HMT AK	CMS NK	NCM SK	INS & MSR NKD	BREAK	SEMINAR		GATE CLASS
TUE	INS & MSR NKD	IE&A IH	NCM SK	DME SG			NCM SK	GATE CLASS
WED	NCM SK	CMS NK	IE&A IH	HMT AK		M1 DME LAB (SG+RKR)/M2 CMS (HKC)		
THU	INS & MSR NKD	IE&A IH	CMS NK	DME SG		M2 DME LAB (SG+RKR)/M1 CMS (HKC)		
FRI	HMT AK	DME SG	INS & MSR NKD			M1 HMT LAB (GK)		
SAT		IE&A IH	GATE CLASS			M2 HMT LAB (GK)		

INS & MSR -Instrumentation and Measurement **NKD - Mr. Niteesh Kumar Dubey**

MIT MUZAFFARPUR

Department of Mechanical Engineering
Instrumentation and Measurement

Assignment I

1. Name the dynamic characteristics of measurement system.
2. What is the meant by calibration of instrument?
3. Explain the static characteristic of an instrument.
4. What are the different type of errors ? Explain how to eliminate errors in instrument ?
5. Discuss zero, first and second order system with example.

Department of Mechanical Engineering
Instrumentation and Measurement

Assignment 2

1. Give the applications of measurement systems.
2. Classify instruments based on their functions.
3. What are the 2 methods for measurement?
4. Explain the function of measurement system.
5. Mention the basic requirements of measurement.
6. What is meant by measurement?

MIT MUZAFFARPUR

Department of Mechanical Engineering
Instrumentation and Measurement

TUTORIAL SHEET

Question 1

(a). Differentiate between measurement and instrument.

(b). A Digital Clamp Meter is used to measure the current flow into a machine at different interval. The results are shown in **Table 1**. Calculate:

(i) Arithmetic mean;

(ii) Deviation for each reading;

(iii) Average deviation;

(iv) Standard deviation;

(v) Precision for most frequent reading.

Table 1

No. of measurement	Frequency of reading	Current, I (A)
1	1	2.002
2	3	1.997
3	1	2.001
4	4	1.996
5	1	1.998

Question 2

(a) Compare accuracy, precision and sensitivity.
(b) The expected value of the current through a resistor is 22 mA. However the Measurement yields a current value of 19 mA. Calculate
(i) Absolute error,
(ii) Percentage of error,
(iii) Relative accuracy, and
(iv) Percentage of accuracy

(c) The output voltage of an amplifier was measured at eight different intervals using the same digital voltmeter with the following results: 20.00, 19.80, 19.85, 20.05, 20.10, 19.90, 20.25, and 19.95. Which is the most precise measurement?

Question 3

(a) Discuss the difference between random error and systematic error of a Measurement.

(b) Define absolute error.

(c) A 600 mA ammeter is specified to be accurate with ±2%. Calculate the limiting error when instrument is used to measure 300 mA.

MIT MUZAFFARPUR

Department of Mechanical Engineering
Instrumentation and Measurement

TUTORIAL SHEET 2

Question 1

A pressure gauge with a measurement range of 0-10 bar has quoted inaccuracy of 1.0% fs (1% of full-scale reading)

(a) What is the maximum measurement error Expected for this instrument?
(b) What is the likely measurement error expressed as a percentage of output reading if this pressure gauge is measuring pressure of 1 bar?

Question 2

A packet of resistor brought in an electronics component shop gives the nominal resistance value as 1000 ohm and the manufacturing tolerance as 5%. If one resistor is chosen at random from the packet, what is the minimum and maximum resistance value that this particular resistor is likely to have

MIT MUZAFFARPUR

Department of Mechanical Engineering
Instrumentation and Measurement

TUTORIAL SHEET 3

Question 1

Discuss in details of Resistance Transducer covering
(i) Principle of working
(ii) Circuit diagram
(iii) Advantages and Disadvantages

Question 2
Discuss the Active and Passive transducers in details.

MIT MUZAFFARPUR

Department of Mechanical Engineering
Instrumentation and Measurement

TUTORIAL SHEET 4

Question 1
Explain the construction and working of Bourdon Tube.

Question 2
Explain the construction & working of LVDT.

Question 3
Explain the construction and working of RTD. What are the desirable properties of material to be used as RTD's? Write salient features of RTD's.

Question 3
What are thermistors? Explain their different forms of construction. Draw their resistivity various temperature characteristics

MIT Muzaffarpur

B.Tech 6th Semester Mid-Term Examination, 2018

Instrumentation & Measurement (02 1x19) **Full Marks:20**

Note: Question number 1 is compulsory, Attempt any four question.
Each question carry 5 marks

1. Figure to the right shows a mass measurement scale using a spring.

1.1. The span of the scale is
a) 16 kg
b) 21 kg
c) 11 kg
d) 5 -16 kg

1.2. The range of the scale is
a) 16 kg
b) 21 kg
c) 11 kg
d) 5 -16 kg

1.3 The resolution of the measurement device is
a) 0.5kg
b) 1 kg
c) 11 kg
d) 5 -16 kg

1.4 Two resistors R_1 =36Ω ± 5% and R_2 =75Ω ±5% are connected in series. Their total resistance is
a) 111 ± 0 Ω
b) 111 ± 2.778 Ω
c) 111 ± 5.55 Ω
d) 111 ± 5%

1.5. Which one is the static characteristic of the instrument?
a) Time delay
b) Dynamic error
c) Dead Space
d) Fidelity

2. a) What are the main elements in measurement system and what are their function.
b) What are the main factor governing the choice of a measuring instrument for a given application.

3. Briefly explain minimum five ways in which measuring instrument can be subdivided in different classes according to their mode of operation, Give the example of instrument in to each classes and also give the advantage and disadvantage of each ways

4. a) Give the brief description about the following given below
   1. Accuracy and Precision
   2. Mode of measurement

3. Threshold and resolution
4. Drift and hysteresis

b) An instrument is calibrated in the environment at temperature 20 degree Celsius and following output reading y are obtained for various input reading.

Y=	13.1	26.2	39.3	52.4	65.5	78.6
X=	5	10	15	20	25	30

Determine the measurement sensitivity and also show which type of relation exist between input and output.

5. Describe about the input and output configuration of measurement system and also discuss about the methods of correction for the interfering and modifying input.

7. (a) Explain briefly the types of errors encountered in a transducer. 7

(b) What do you mean by semiconductor strain gauges? 7

8. (a) What is linear variable differential transformer (LVDT)? List the advantages and disadvantages of LVDT. 7

(b) The output of an LVDT is connected to a 10 A ammeter through an amplifier whose amplification factor is 200. An output of 3 mA appears across the terminals of LVDT when the core moves through a distance of 0·75 mm. Calculate the sensitivity of LVDT and that of the whole setup. The milliammeter scale has 100 divisions. The scale can be read to 1/10 of a division. Determine the resolution of the instrument in mm. 7

9. What do you mean by data acquisition systems (DASs)? Explain with the help of block diagram, single-channel and multi-channel DAS. 14

* * *

B.Tech 6th Semester Exam., 2016

INSTRUMENTATION AND MEASUREMENT

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.

1. Write True or False (any *seven*) : 2×7=14

(a) The equivalent binary number of decimal number 27 is 11011.

(b) The equivalent decimal number of binary number 101011 is 43.

(c) The temperature measured by a thermocouple is primary measurement.

(d) Environmental errors may be due to change in wind velocity.

(e) A second-order underdamped system has a damping factor of 0·8. It is subjected to a sinusoidal input of unit amplitude. It has resonant peak of 92%.

(f) A first-order thermometer has a time constant of 50 seconds. It is subjected to a sinusoidal input cycling at 0·002 Hz. The time lag of the instrument is 50 seconds.

(g) A set of readings has a wide range and therefore it has low precision.

(h) LVDT is a capacitive transducer.

(i) The most suitable device for measuring temperature of a furnace is optical pyrometer.

(j) Strain gauge cannot be used to measure pressure.

2. (a) Discuss the factors relating the selection of instruments. 5

(b) Describe briefly the main functions of the instruments with suitable examples. 9

3. (a) What are the main static characteristics of measuring instruments? Discuss the terms – accuracy, errors and correction. 9

(b) A pressure indicator showed a reading as 42 bar on a scale range of 0–50 bar. If the true value was 41·4 bar, determine (i) static error, (ii) static correction and (iii) relative static error. 5

(Continued)

4. The temperature of a furnace is found to vary sinusoidally between 520° C and 580° C with a periodic time of 50 seconds. A thermocouple system with a time constant of 10 seconds is employed to measure the furnace temperature. Determine—

(a) the maximum and minimum values that will be indicated by the thermocouple;

(b) the phase shift and the corresponding time lag between the temperature signals and the thermocouple input signals. 14

5. Discuss zero-, first- and second-order systems with suitable examples. 14

6. By using a micrometer screw, the following readings were taken of a certain physical length :

1·34, 1·38, 1·56, 1·47, 1·42, 1·44, 1·53, 1·48, 1·40 and 1·59 mm

Assuming that only random errors are present, calculate the following : 14

(a) Arithmetic mean

(b) Average deviation

(c) Standard deviation

(d) Variance

(Turn Over)

Evaluation Criterion for Internal Marks

Instrumentation and Measurement

Total Internal Marks = 30

Sessional (Midterm Exam) = 20

Attendance = 5

Assignment and Class Tests and quizzes = 5

Final marks for Istrumentation and Measurement subject of 6th Semester (Mechanical)				
Roll No	**Attendence Marks out of 5**	**Assignment / Quiz Marks out of 5**	**End Sem Marks out of 20**	**Total Marks out of 30**
15M1	5	5	15	25
15M2	5	5	18	28
15M3	4	5	8	17
15M4	4	5	13	22
15M5	4	5	15.5	24.5
15M6	4	5	10	19
15M7	4	5	15	24
15M8	4	5	11	20
15M9	5	5	18.5	28.5
15M10	5	5	19	29
15M11	4	5	9.5	18.5
15M12	4	5	15.5	24.5
15M13	4	5	8	17
15M14	4	5	11	20
15M15	5	5	15.5	25.5
15M16	4	5	11.5	20.5
15M17	4	5	14.5	23.5
15M18	4	5	16.5	25.5
15M19	4	5	11	20
15M20	4	5	11	20
15M21	4	5	9.5	18.5
15M23	5	5	18	28
15M24	5	5	15.5	25.5
15M25	4	5	10	19
15M26	4	5	11.5	20.5
15M28	4	5	9	18
15M29	4	5	11.5	20.5
15M30	4	5	10.5	19.5
15M31	4	5	7.5	16.5
15M32	4	5	10	19
15M33	4	5	18	27
15M34	4	5	6.5	15.5
15M35	4	5	11.5	20.5
15M36	4	5	8	17
15M37	4	5	10.5	19.5
15M38	4	5	13.5	22.5
15M39	4	5	9	18
15M40	4	5	13.5	22.5
15M41	5	5	19	29
15M42	4	5	14	23
15M44	5	5	16.5	26.5
15M46	4	5	16.5	25.5

Roll No	Attendence Marks out of 5	Assignment / Quiz Marks out of 5	End Sem Marks out of 20	Total Marks out of 30
15M47	5	5	19	29
15M48	4	5	10	19
15M49	4	5	14	23
15M50	4	5	18	27
15M51	4	5	11.5	20.5
15M52	4	5	9	18
15M53	5	5	18.5	28.5
15M54	4	5	10	19
15M55	5	5	19	29
15M56	4	5	14.5	23.5
15M57	4	5	14	23
15M58	4	5	10	19
15M59	4	5	15.5	24.5
15M60	4	5	9.5	18.5
15M61	5	5	18	28
15M62	4	5	7.5	16.5
15M63	5	5	16	26
15M64	5	5	12	22
15M65	4	5	13	22
15M66	4	5	15	24
15M67	4	5	17.5	26.5
16(LE)M1	4	5	17	26
16(LE)M2	4	5	17	26
16(LE)M3	5	5	19	29
16(LE)M4	5	5	14	24
16(LE)M5	4	5	10	19
16(LE)M6	4	5	6.5	15.5
16(LE)M7	5	5	18.5	28.5
16(LE)M8	4	5	9.5	18.5
16(LE)M9	4	5	10	19
16(LE)M10	4	5	9	18

MUZAFFARPUR INSTITUTE OF TECHNOLOGY, MUZAFFARPUR
6th SEMESTER

Branch	Name	Roll. No.
MECHANICAL ENGINEERING	ASHISH CHAURASIA	15M01
	RAJ KAMAL	15M02
	VIVEK KUMAR	15M03
	RAM BHADRA JHA	15M04
	RITU RAJ	15M05
	SUMIT KUMAR	15M06
	PAWAN KUMAR PIYUSH	15M07
	HIMANSHU KUMAR	15M08
	ANMOL	15M09
	MADHU PRIYA	15M10
	SANJAN KUMAR YADAV	15M11
	PRAVEEN KUMAR	15M12
	VIKASH KUMAR KESHRI	15M13
	AHSAN SOHAIL	15M14
	MUKESH KUMAR ROY	15M15
	SAJAN KUMAR	15M16
	SUMAN KUMAR SINHA	15M17
	RITESH KUMAR	15M18
	SHANUR RAHMAN WAHID	15M19
	MD AFTAB ALAM	15M20
	DHEERAJ KUMAR	15M21
	SAROJ KUMAR PASWAN	15M23
	MAYANK	15M24
	ASHOK DAS	15M25
	ALOKRAJ	15M26
	ASHIWANI KUMAR	15M28
	NEHAL ANSARI	15M29
	DHARMENDRA KUMAR	15M30
	ASHVANI KUMAR	15M31
	DHANANJAY KUMAR	15M32
	RAHUL KUMAR	15M33
	RANJAN KUMAR	15M34
	ANURAG KUMAR RAVI	15M35
	RAVI RAJ	15M36
	ANKIT AKASH	15M37
	PRAMENDRA KUMAR	15M38
	RAMESH KUMAR	15M39
	GANGA RAM MANDAL	15M40
	ROHIT KUMAR	15M41
	UJJWAL KASHYAP	15M42
	NISHANT KIRAN	15M44

	AMAN KUMAR JHA	15M46
	NITISH KUMAR	15M47
	NAVEEN KUMAR	15M48
	DHANANJAY KUMAR CHOUDHARY	15M49
	AAKASH KUMAR	15M50
	DEEPAK KUMAR	15M51
	SURANJAN KUMAR	15M52
MECHANICAL ENGINEERING	MONU KUMAR	15M53
	SANJEEV KUMAR ADITYA	15M54
	ISHA SHARMA	15M55
	NEETU GUPTA	15M56
	AMIT KUMAR	15M57
	MERAJ AHMED	15M58
	MANISH KUMAR SINGH	15M59
	ABHINANDAN KUMAR	15M60
	RAM KUMAR MAHTO	15M61
	ROHIT RAJ	15M62
	VIKAS KUMAR SAXENA	15M63
	SUMIT KUMAR	15M64
	PRAKASH KUMAR	15M65
	ANAND MOHAN DEO	15M66
	ADITYA KUMAR	15M67
	ADITYA KUMAR	16(LE)M01
	SHAKTI KUMAR	16(LE)M02
	ROHIT KUMAR	16(LE)M03
	KUMARI PRIYA RANJAN	16(LE)M04
	KAMLESH KUMAR	16(LE)M05
	KUMAR PRATIK VISHWAS	16(LE)M06
	VIKRANT KUMAR	16(LE)M07
	NIRBHAY KUMAR	16(LE)M08
	RAUSHAN KUMAR SINGH	16(LE)M09
	HIMANSHU CHANDRA	16(LE)M10