DARBHANGA COLLEGE OF ENGINEERING, DARBHANGA, BIHAR

COURSE FILE

OF

INTELLIGENT INSTRUMENT

Course Code: 041706

Faculty Name:

MR. SHAKTI PRASAD SENAPATI

ASSISTANT PROFESSOR, DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

विज्ञान एवं प्रावैधिकी विभाग
Department of Science and Technology
Government of Bihar

CONTENTS

Department of Electrical and Electronics Engineering

Vision of the Institute

To produce young, dynamic, motivated and globally competent Engineering graduates with an aptitude for leadership and research, to face the challenges of modernization and globalization, who will be instrumental in societal development.

Mission of the Institute

1. To impart quality technical education, according to the need of the society.
2. To help the graduates to implement their acquired Engineering knowledge for society & community development.
3. To strengthen nation building through producing dedicated, disciplined, intellectual & motivated engineering graduates.
4. To expose our graduates to industries, campus connect programs & research institutions to enhance their career opportunities.
5. To encourage critical thinking and creativity through various academic programs.

Vision of the Department

To bring forth engineers with an emphasis on higher studies and a fervour to serve national and multinational organisations and, the society.

Mission of the Department

M1: - To provide domain knowledge with advanced pedagogical tools and applications.

M2: - To acquaint graduates to the latest technology and research through collaboration with industry and research institutes.

M3: - To instil skills related to professional growth and development.

M4: - To inculcate ethical valued in graduates through various social-cultural activities.

PEO of EEE

PEO 01 – The graduate will be able to apply the Electrical and Electrical Engineering concepts to excel in higher education and research and development.

PEO 02 – The graduate will be able to demonstrate the knowledge and skills to solve real life engineering problems and design electrical systems that are technically sound, economical and socially acceptable.

PEO 03 – The graduates will be able to showcase professional skills encapsulating team spirit, societal and ethical values.

PSO of EEE

PSO 01 Students will be able to identify, formulate and solve problems using various software and other tools in the areas of Automation, Control Systems, Power Engineering and PCB designing.

PSO 02 Students will be able to provide sustainable solutions to growing energy demands.

Course Descriptions

This course is designed to review the fundamentals and practices of to acquire the basic knowledge of Intelligent Instruments, operational amplifier, linear, non-linear application of OP-AMP, basic concept of sensor & transducer and smart sensor. It covers design and analysis active filters, PLL, A/D & D/A convector and its use to prepare students to perform the analysis and design of various linear integrated circuits.

Course Objectives:

1. Understand the characteristics and features of intelligent instrumentation systems.
2. Understand the functioning of OP-AMP and design OP-AMP based circuits.
3. Design of smart sensors and understand concept of data compensation,
4. Understand the process of data transfer control and Design of data converters.

Course Outcomes:

CO1: Understand the fundamental concepts of intelligent instruments and its characteristics.

CO2: Design the basic circuits using op-amp and perform operations and their troubleshooting.

CO3: Understand different filters, their design and various applications in practical situations.

CO4: Design the basic building blocks of smart sensors and interfacing devices.

CO5: Analyse the basic building blocks of different types A/D and D/A converters.

CO-PO MAPPING

Sr. No.	Course Outcome	PO
1.	CO.1 Have a thorough understanding of the fundamental concepts of intelligent instruments and its characteristics.	1,2
2.	CO.2 To design the basic circuits using op-amp and perform operations and their troubleshooting.	1,2,3,4,5,6,12
3.	CO.3 To Understand the basic building blocks of smart sensor and interfacing devices.	1,2,5,6,12
4.	CO.4 To understand, analyse and design basic building blocks of different types A/D and D/A converters.	1,2,3,5,6,12
5.	CO.5 To understand and the basics of memory and timer circuits.	1,2,5,12

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO.1 Have a thorough understanding of the fundamental concepts of intelligent instruments and its characteristics.	√	√										
CO.2 To design the basic circuits using op-amp and perform operations and their troubleshooting.	√	√	√	√	√	√						√
CO.3 To Understand the basic building blocks of smart sensor and interfacing devices.	√	√			√	√						√
CO.4 To understand and analyse basic building blocks of different types A/D and D/A converters.	√	√	√		√	√						√
CO.5 To understand and the basics of memory and timer circuits	√	√			√							√

B. Tech. VII Semester (EEE)
Intelligent Instruments

L T P/D Total
L-T-P :
4-1-2

Max Marks: 100

Final Exam: 70 Marks
Sessional: 20 Marks
Internals: 10 Marks.

INTELLIGENT INSTRUMENTATION

L-T-P: 3-0-3 Credit : 5

Theory:

1. Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation. Lecture : 6

2. Signal amplification & attenuation (OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization(different types such as diode resistor combination, OP-AMP based etc.), bias removal signal filtering (output from ideal filters, output from constant – k filters, matching of filter sections, active analog filters). Lecture: 10

3. OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter. Lecture: 8

4. Smart sensors: Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface. Lecture 10

5. Interfacing instruments and computers: basic issues of interfacing address decoding; data transfer control, A/D convertor, D/A convertors, sample & hold circuit, other interface considerations. Lecture: 8

Text Books: 1. Principles of measurements and instrumentation by Alan S Morris, PHI
2. Intelligent instrumentation by Bamay, G.C.Prentice Hall

Reference Books: 1. Sensors and transducers by Parranabis, PHI
2. Introduction to digital signal processing: MGH

GATE Syllabus of Intelligent Instrument

This subject is not in GATE syllabus.

Darbhanga College of Engineering, Darbhanga (Bihar)

Time table: Intelligent Instrument, 7th Sem.
Room No.-

Day/ time	10:00-10:50	10:50-11:40	11:40-12:30	12:30-1:20	1:20-2:00	2:00-2:50	2:50-3:40	3:40-4:30
MON		II			**B**	II LAB		
TUE	II				**R**			
WED								
THU					**E**			
FRI		II			**A**			
SAT					**K**	II LAB		

Darbhanga College of Engineering, Darbhanga(Bihar)

7th Semester, EEE Branch

Branch	S.N.	Registration No.	Student Name
EEE	1	17110111001	RAUSHAN MISHRA
EEE	2	17110111002	GULSHAN KUMAR
EEE	3	17110111003	ROSHAN KUMAR
EEE	4	17110111004	ARUNODAY LAL
EEE	5	17110111005	PRANTIKA SUMAN
EEE	6	17110111006	HIMANI
EEE	7	17110111007	CHANDAN KUMAR
EEE	8	17110111008	SUBHKANT SAHU
EEE	9	17110111009	SHAMIM AKHATAR
EEE	10	17110111010	AKSHAY KUMAR
EEE	11	17110111011	SUBHAM KUMAR
EEE	12	17110111012	PRITY SINHA
EEE	13	17110111013	FUDAN KUMAR
EEE	14	17110111014	JYOTI KUMARI
EEE	15	17110111015	GAURAV KUMAR
EEE	16	17110111016	ARVIND KUMAR
EEE	17	17110111017	GOVIND KUMAR
EEE	18	17110111018	KESHAV KUMAR
EEE	19	17110111019	MUNNA KUMAR
EEE	20	17110111020	ABHIJEET KUMAR
EEE	21	17110111021	AJAY RAJ
EEE	22	17110111022	DEEPIKA KUMARI
EEE	23	17110111023	LEEPI DAS
EEE	24	17110111024	VIKASH KUMAR
EEE	25	17110111025	UDAY KUMAR YADAV
EEE	26	17110111026	HEMANT KUMAR
EEE	27	17110111027	SHUBHAM KUMAR ANAND
EEE	28	17110111028	MD TAUHID
EEE	29	17110111029	MD ASIF
EEE	30	17110111031	AMAN KUMAR
EEE	31	17110111032	AMAN JAISWAL
EEE	32	17110111033	RAVI NAYAN KISHOR
EEE	33	17110111034	DILIP KUMAR
EEE	34	17110111035	ANIL KUMAR
EEE	35	17110111036	MD RAFIULLAH
EEE	36	17110111037	SHASHANK KUMAR
EEE	37	17110111038	SAKSHI SUMAN
EEE	38	17110111039	SUNIL KUMAR RAM
EEE	39	17110111041	RAHUL KUMAR
EEE	40	17110111042	SATYAM KUMAR
EEE	41	17110111043	DIPU KUMAR MISHRA
EEE	42	17110111044	VIKASH KUMAR

EEE	43	17110111045	SAROJ KUMAR
EEE	44	17110111046	AJAY KUMAR SINGH
EEE	45	17110111047	MD NAYEEM
EEE	46	17110111048	MD SHAMIM AKHATAR
EEE	47	17110111049	DEEPA KUMARI
EEE	48	17110111050	SUBHASH KUMAR
EEE	49	17110111051	PRIYA KUMARI
EEE	50	17110111052	AMRENDRA KUMAR
EEE	51	17110111053	RANI RUPA
EEE	52	17110111054	AMAN KUMAR SRIVASTVA
EEE	53	17110111055	ADITYA KUMAR
EEE	54	17110111056	RAUSHAN KUMAR RAM
EEE	55	17110111057	POOJA KUMARI
EEE	56	17110111058	AVINASH KUMAR MISHRA
EEE	57	17110111059	RAHUL KUMAR
EEE	58	17110111060	VARUN KUMAR
EEE	59	17110111061	BRAJESH KUMAR
EEE	60	17110111063	ALOK KUMAR
EEE	61	17110111064	ROHIT KUMAR SAH
EEE	62	17110111065	MAYANK RAJ
EEE	63	18110111901	RAJESH KUMAR
EEE	64	18110111902	NAVEEN KUMAR
EEE	65	18110111903	NIKITA RAJ
EEE	66	18110111904	RITU RAJ
EEE	67	18110111905	SONAKSHI KUMARI
EEE	68	18110111906	PAWAN KUMAR
EEE	69	18110111907	NITISH KUMAR BANTY
EEE	70	18110111908	ADITYA CHANDRA RANJAN
EEE	71	18110111909	KUMARI SUPRABHA
EEE	72	18110111910	BRAJ KISHORE
EEE	73	18110111911	SAKSHI KUMARI
EEE	74	18110111912	VIDYAPATI CHAURASIYA
EEE	75	17110111904	LALIT KUMAR RAM
EEE	76	17110111907	DEEPAK KUMAR PRABHAT

Course Hangout

Institute / College Name :	DCE, Darbhanga, Bihar		
Program Name	**INTELLIGENT INSTRUMENT**		
Course Code	041706		
Course Name	**INTELLIGENT INSTRUMENT**		
Lecture / Tutorial (per week):	4/1	**Course Credits**	5
Course Coordinator Name	SHAKTI PRASAD SENAPATI		

1. Scope and Objectives of the Course

This course is designed to review the fundamentals and practices of to acquire the basic knowledge of operational amplifier, linear, non-linear application of OP-AMP, basic concept of sensor & transducer and smart sensor. It covers design and analysis active filters, PLL, A/D & D/A convertor and its use to prepare students to perform the analysis and design of various linear integrated circuits.

2. Textbooks

TB1: 'Linear Integrated Circuit, third edition,D.Roy Choudhary,shail B. Jain, New age international publication

TB2: Sensors and transducers by Parranabis, PHI

3. Reference Books

1. Ramakant A.Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th edition, Pearson education
2. Coughlin & Driscoll, "Operational-Amplifiers and Linear Integrated Circuits", 6th edition, Pearson educatio

Other readings and relevant websites

S.No.	**Link of Journals, Magazines, websites and Research Papers**
1.	http://www.srmuniv.ac.in/sites/default/files/downloads/ec0206_linear_integrated_circuits_2013_14.pdf
2.	https://www.accessengineeringlibrary.com/browse/troubleshooting-electronic-equipment-includes-repair-and-maintenance-second-edition/c9780070483576ch09
3.	https://en.wikipedia.org/wiki/Linear_integrated_circuit
4.	http://www.sincomindia.com/linear-integrated-circuits-section-e-op-amp-applications-circuit.html

5. Course Plan

Sl. No.	Topic Name	Periods
	1.INTRODUCTION	
1.1	Introduction and features characterizing intelligence	1
1.2	Intelligent instrumentation system: static and dynamic system	2
1.3	Components and block diagram	1
	2. OP-AMP BASED CIRCUITS	
2.1	Signal amplification: Basic of opamp, Inverting and Non-inverting, adder, subtractor circuit etc..	**3**
2.2	V-I,I-V convertor, integration, Differentiator etc	2
2.3	Log and antilog amplifier, multiplier , Divider Circuit	1
2.3	Instrumentation amplifier	1
2.4	voltage comparator	2
2.5	Signal linearization(+ and *)	1
2.6	Filters: basics of pasive and active analog filter	1
2.7	Active LPF and HPF	2
2.8	Active BPF, BRF and all pass filter	2
2.9	Description of spike filter and K-filter	1
2.1	PLL: Introduction, types of pll,block diagram of pll	3
	3. SMART SENSOR	
3.1	Introduction and Primary sensors, excitation	2
3.2	Compensation:	2
3.3	Data compensation	2
3.4	Information coding/processing,	1
3.5	Standard for smart sensor interface	1
	4. INTERFACING INSTRUMENTS	
4.1	Introduction and : basic issues of interfacing	1
4.2	Address decoding	2
4.3	Data transfer control	1
4.4	Other interface considerations	1
4.5	Sample & hold circuit	2
4.6	A/D convertor:	2
4.7	D/A convertor:	2
	TOTAL	**42**

1. **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
Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation.	6	14%
Signal amplification & attenuation(OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization(different types such as diode resistor combination, OP-AMP based etc.), bias removal signal filtering (output from ideal filters, output from constant –k filters, matching of filter sections, active analog filters).	10	24%
OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter.	8	19%
Smart sensors : Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface.	10	24%
Interfacing instruments and computers :basic issues of interfacing, address decoding, data transfer control, A/D convertor, D/A convertors, sample & hold circuit, other interface considerations.	8	19%

This Document is approved by:

Designation	**Name**	**Signature**
Course Coordinator	Mr. SHAKTI PRASAD SENAPATI	
H.O.D	Mr. Prabhat Kumar	
Principal	Dr. Achintya	
Date	20.02.2021	

Darbhanga College of Engineering, Darbhanga (Bihar)

(Established under AICET Act, _____)

Department of Electrical and Electronics Engineering
Intelligent instruments

1. Answer the following:-
   (i) Define quality factor. What is quality factor for band pass active filter..
   (ii) What are the properties of instrumentation amplifier?
   (iii) Draw the circuit diagram of an ideal and practical integrator.
   (iv) Define active filter .What are the advantages of active filter
   (v) What do you mean by signal linearization?
   (vi) Define and draw the circuit diagram of wide band reject filter.
2. Draw the circuit diagram of Schmitt trigger and explain its working. .
3. Design a second order low pass active filter with cutoff frequency 1 kHz. Given $c_1=c_2=0.0047\mu F$
4. Derive the gain expression for second order Butterworth high pass filter.
5. Draw the circuit diagram of instrumentation amplifier and derive the expression for gain.
6. Write short notes: (a) Signal multiplier (b) V to I and I to V converter.

Assignment 2

1. What do you mean by sample and hold circuit. Explain its circuit operation.
2. State and explain different components of intelligent instrumentation system.
3. What is basically the concept of smart sensors? What are the essential elements in such an unit? Show with the help of a diagram, the arrangement of these element
4. What are basic issues of interfacing instruments with computers? Write about data transfer control in detail.
5. Explain the various methods used for ADC. Explain anyone of them in detail. Also describe resolution, quantization error in ADC.

Institute / School Name	**Darbhanga College of Engineering, Darbhanga(Bihar)**		
Program Name	B.Tech		
Course Code	041706P		
Course Name	Intelligent Instruments Lab		
Labs (per week)	2	**Course Credits**	
Course Coordinator Name	Mr. SHAKTI PRASAD SENAPATI		

1. Scope and Objectives of the Course

This is a course on the design and applications of operational amplifiers and sensors. This course introduces basic op-amp principles and show how the op-amp can be used to solve a variety of application problems. Much attention is given to basic op-amp configurations, linear and non-linear applications of op-amp and active filter synthesis, the course is designed as per the Bureau of Indian Standard guidelines which prepares the students for the future.

2. Reference Books

RB1: Concrete Lab Manual

3. Other readings and relevant websites

S.No.	Link of Journals, Magazines, websites and Research Papers
1.	http://www.srmuniv.ac.in/sites/default/files/downloads/ec0206_linear_integrated_circuits_2013_14.pdf
2.	http://www.eee.griet.ac.in/wp-content/uploads/2014/12/OPAM-Course-File.pdf

4. Lab Plan

S.No.	Title of Experiment
1	To design and verify inverting amplifier using multisim
2	To design and verify non- inverting amplifier using multisim
3	To design and verify summing amplifier using multisim.
4	To design and verify an instrumentation amplifier using multisim.
5	To design and verify integrator using multisim.
6	To design and verify differentiator using multisim
7	To design and verify low pass filter using multisim.
8	To design and verify High Pass Filter using multisim

3. Evaluation Scheme:

Component 1*	Lab Performance / File work	
Component 2	Internal Viva – Voce	
Component 3**	End Term	30
	total	50

*Lab Performance will be evaluated weekly

**The End Term examination for practical courses is held at the end of semester and includes conduct of experiment and an oral examination (viva voce).The mandatory requirement of 75% attendance in all lab classes is to be met for being eligible to appear in this component

This document is approved by

Designation	**Name**	**Signature**
Course Coordinator	Mr. SHAKTI PRASAD SENAPATI	
HoD	Mr. Prabhat Kumar	
Principal	Dr. Achintya	
Date	20.02.2021	

Lecture Plan

Sl. No.	Topic Name	Periods
	1.INTRODUCTION	
1.1	Introduction and features characterizing intelligence	1
1.2	Intelligent instrumentation system: static and dynamic system	2
1.3	Components and block diagram	1
	2. OP-AMP BASED CIRCUITS	
2.1	Signal amplification: Basic of opamp,Inverting and Non-inverting, adder, subtractor circuit etc..	**3**
2.2	V-I,I-V convertor, integration, Differentiator etc	2
2.3	Log and antilog amplifier, multiplier , Divider Circuit	1
2.3	Instrumentation amplifier	1
2.4	voltage comparator	2
2.5	Signal linearization(+ and *)	1
2.6	Filters: basics of pasive and active analog filter	1
2.7	Active LPF and HPF	2
2.8	Active BPF, BRF and all pass filter	2
2.9	Description of spike filter and K-filter	1
2.1	PLL: Introduction, types of pll,block diagram of pll	3
	3. SMART SENSOR	
3.1	Introduction and Primary sensors, excitation	2
3.2	Compensation:	2
3.3	Data compensation	2
3.4	Information coding/processing,	1
3.5	Standard for smart sensor interface	1
	4. INTERFACING INSTRUMENTS	
4.1	Introduction and : basic issues of interfacing	1
4.2	Address decoding	2
4.3	Data transfer control	1
4.4	Other interface considerations	1
4.5	Sample & hold circuit	2
4.6	A/D convertor:	2
4.7	D/A convertor:	2
	TOTAL	**42**

Department of Electrical and Electronics Engineering
Intelligent Instruments

Assignment I

1. Answer the following:-
   (i) Define quality factor. What is quality factor for band pass active filter..
   (ii) What are the properties of instrumentation amplifier?
   (iii) Draw the circuit diagram of an ideal and practical integrator.
   (iv) Define active filter .What are the advantages of active filter
   (v) What do you mean by signal linearization?
   (vi) Define and draw the circuit diagram of wide band reject filter.
2. Draw the circuit diagram of Schmitt trigger and explain its working. .
3. Design a second order low pass active filter with cutoff frequency 1 kHz. Given $c_1=c_2=0.0047\mu F$
4. Derive the gain expression for second order Butterworth high pass filter.
5. Draw the circuit diagram of instrumentation amplifier and derive the expression for gain.
6. Write short notes: (a) Signal multiplier (b) V to I and I to V converter.

Assignment 2

1. What do you mean by sample and hold circuit. Explain its circuit operation.
2. State and explain different components of intelligent instrumentation system.
3. What is basically the concept of smart sensors? What are the essential elements in such an unit? Show with the help of a diagram, the arrangement of these element
4. What are basic issues of interfacing instruments with computers? Write about data transfer control in detail.
5. Explain the various methods used for ADC. Explain anyone of them in detail. Also describe resolution, quantization error in ADC.

Mid-Term Papers

Darbhanga College of Engineering, Darbhanga

EEE Department

B.Tech [7th Sem (EEE)]

Mid. Sem Exam

(Session: 2018-19)

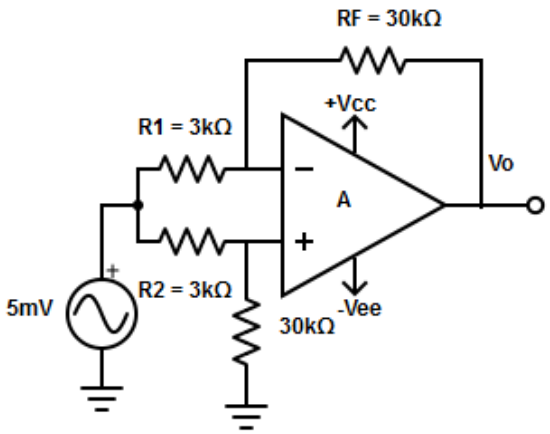
***Subject Code*-041706**

Intelligent Instrumentation

Time: 2 Hours ***Max. Marks: 20***

Note: Attempt any 4 questions out of 5 given questions. Each question carries 5 marks.

1. Draw the circuit diagram of an instrumentation amplifier and derive the expression for its gain. **[5]**
2. Discuss the components of an intelligent instrumentation system with help of suitable block diagram. **[5]**
3. Write the short note of the following. **[5]**
   A. Sensor
   B. Transducer
   C. Accuracy
   D. Precision
4. Define the Common-Mode Rejection Ratio (CMRR) of OP-AMP? Find out the CMRR of the following Circuit given below**.** **[5]**



5. Draw the block diagram of intelligent instrumentation. Mention the features characterizing intelligence. **[5]**

Darbhanga College of Engineering, Darbhanga

EEE Department

B.Tech [7th Sem (EEE)]

Mid. Sem Exam

(Session: 2019-20)

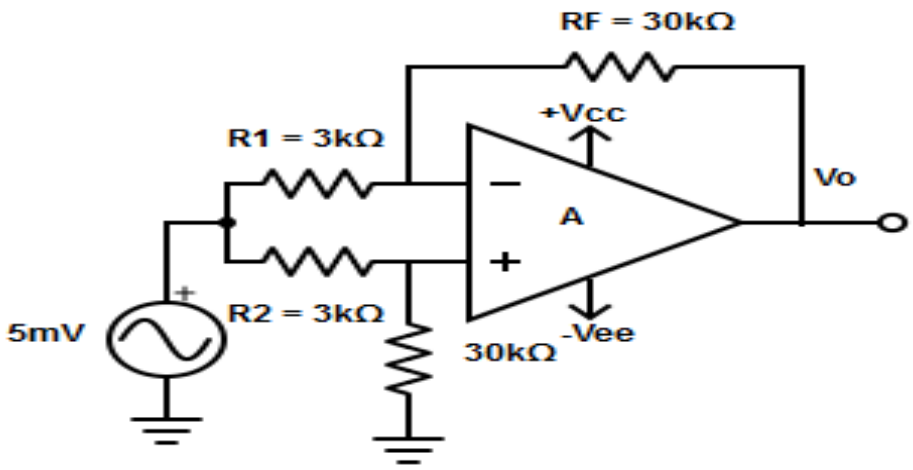
***Subject Code*-041706**

Intelligent Instrumentation

Time: 2 Hours ***Max. Marks: 20***

Note: Attempt all questions. CO–Course Outcomes, BL–Bloom Level

S. No.	Questions	Marks	CO	BL
1.	Discuss the components of an intelligent instrumentation system with help of suitable block diagram. Or What is an intelligent instrumentation system? Write down the features characterizing intelligent instrumentation system.	**5**	**CO1**	**L1**
2.	Define the Common-Mode Rejection Ratio (CMRR) of an OP-AMP? Find out the CMRR of the following Circuit given below**.**	**5**	**CO2**	**L5**

	 Or Draw the circuit diagram of differential amplifier and derive the expression of its gain. Explain how its CMRR can be removed.			
3.	Draw the circuit diagram of an instrumentation amplifier and derive the expression for its gain. Also write the difference between Op-Amp and instrumentation Amplifier. Or Draw the block diagram of intelligent instrumentation and discuss its different blocks.	**5**	**CO3**	**L4**
4.	Write the short notes of the following. A. Accuracy B. Precision Or A. Sensor B. Transducer	**5**	**CO1**	**L2**

1. Answer the the following:-
   (i) Define quality factor. What is quality factor for band pass active filter.
   (ii) What are the properties of instrumentation amplifier?
   (iii) Draw the circuit diagram of an ideal and practical integrator.
   (iv) Define active filter .What are the advantages of active filter.
   (v) What do you mean by signal linearization?
   (vi) Define and draw the circuit diagram of wide band reject filter.
   (vii) What is basic difference between intelligent instrumentation system and instrumentation system?
   (viii) Why we need compensation?

2. (a) Draw the circuit diagram of Schmitt trigger and explain its working.
   (b) Describe the features of intelligent instrumentation. Give the block diagram of intelligent instrumentation system.
3. State and explain different components of intelligent instrumentation system.
4. (a) Derive the gain expression for first order butter-worth high pass filter. Draw its frequency response curve.
5. (a) Draw the circuit diagram of instrumentation amplifier and derive the expression for gain.
   (b) What do you mean by sample and hold circuit. Explain its circuit operation.
6. (a) What is basically the concept of smart sensors? What are the essential elements in such an unit? Show with the help of a diagram, the arrangement of these elements.
   (b) What is signal linearization? How you can achieve linear response by using op-amp.
7. (a) What are basic issues of interfacing instruments with computers? Write about data transfer control in detail.
   (b) Explain the various methods used for ADC. Explain anyone of them in detail. Also describe resolution, quantization error in ADC.
8. (a) What is thermistor? Describe its working and its important characteristics.
   (b) Explain the different principles of working of capacitive transducers.
9. Write short notes:
   (a) Signal multiplier (b) Piezo-electric effect.
   (c) Cubic spline interpolation method (d) Information coding/processing

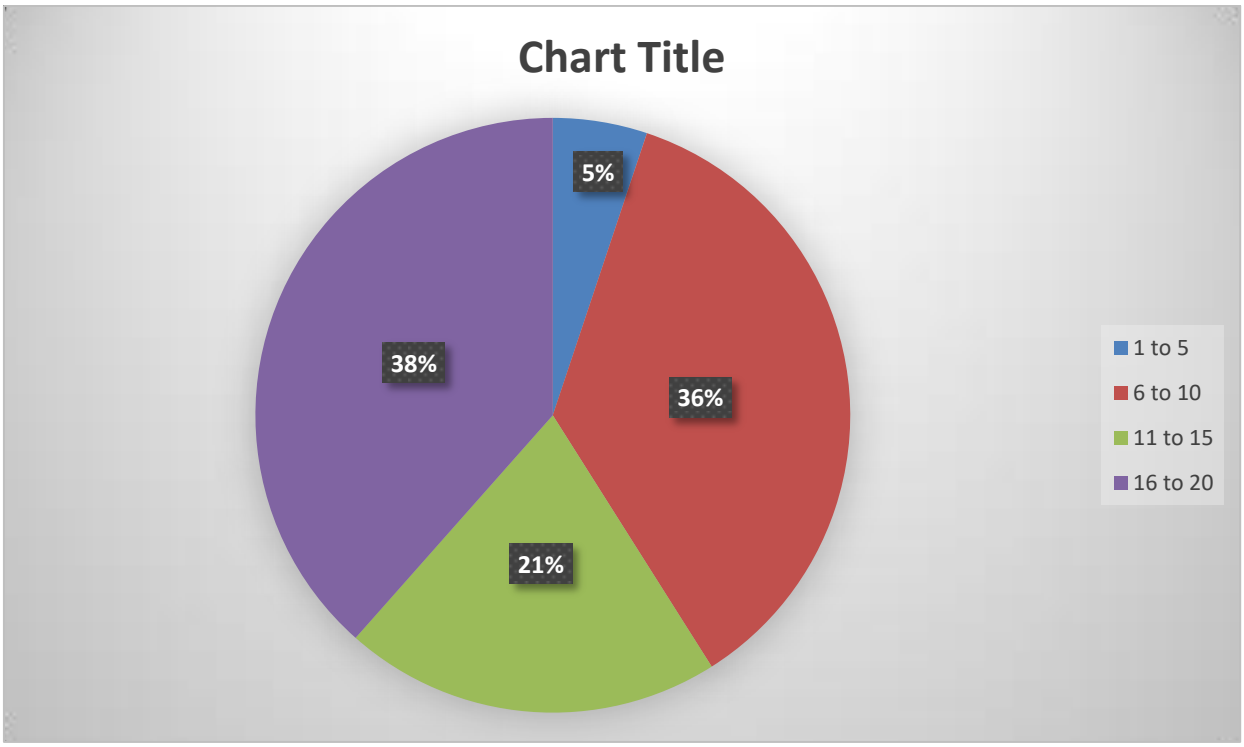


Chart Title
5%
36%
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38%
1 to 5
6 to 10
11 to 15
16 to 20