



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Name	:	INSTRUMENTATION AND CONTROL SYSTEMS
Course Code	:	A70343
Class	:	IV B. Tech I Semester
Branch	:	Mechanical Engineering
Year	:	2018 – 2019
Course Coordinator	:	Mr B D Y Sunil, Assistant Professor, Department of ME
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OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process.

SNo	QUESTION	Blooms taxonomy level	Course Outcomes
UNIT - I			
INTRODUCTION TO MEASUREMENT			
Part - A(Short Answer Questions)			
1	What is meant by measurement?	Remember	1
2	State the two conditions to be satisfied for the result of measurement to be meaningful.	Understand	1
3	Give two examples for primary measurement.	Understand	1
4	What is secondary measurement?	Understand	1
5	What is a primary sensing element?	Understand	1
6	Define the term 'STANDARD'.	Remember	1
7	Define a measuring instrument.	Remember	1
8	What is null type instrument?	Remember	1
9	What are analog and digital instruments?	Remember	1
10	Give examples for automated and manually operated instruments.	Remember	1
11	Give two examples for non contacting instruments.	Understand	1
12	What are intelligent instruments?	Remember	1

13	Differentiate the terms 'accuracy' and 'precision'.	Remember	1
14	Define the term error.	Remember	1
15	What is systematic error?	Remember	1
16	What is random error?	Understand	1
17	What is loading error?	Understand	1
18	What is chaotic error?	Understand	1
19	Define the term calibration.	Understand	1
20	Why instruments are to be calibrated?	Remember	1
21	What is meant by primary calibration?	Remember	1
22	What is secondary calibration?	Remember	1
23	What are mechanical instruments?	Remember	1
24	List two deflection type instruments.	Understand	1
25	What is a power operated instrument?	Understand	1
Part - B (Long Answer Questions)			
1	List the various measurement methods and explain them.	Remember	1
2	Draw the block diagram of a generalized measurement system and explain its various elements.	Remember	1
3	With the help of an example, explain the generalized measurement system.	Understand	1
4	Briefly explain the applications of measuring instruments.	Understand	1
5	List the various types of measuring instruments and explain each one of them.	Understand	1
6	Classify various errors and explain them in detail.	Understand	1
7	Elaborate on the procedure adopted for calibrating instruments.	Remember	1
8	With suitable examples, explain how flow measuring instruments are calibrated by the primary and secondary calibration methods.	Remember	1
9	Briefly discuss on calibration of temperature measuring devices with suitable examples.	Remember	1
10	Explain how strain gauges are calibrated.	Remember	1
11	Discuss on calibration, error and correction curves.	Understand	1
12	a) Define measurement and explain its significance in our day-to-day life. b) What are different sources of errors in measuring instruments? Suggest and explain the methods for elimination or minimization of the errors.	Remember	1
13	Explain the dynamic performance characteristics of measuring instruments.	Understand	1
14	Explain the various static characteristics of a measurement system.	Understand	1
15	Explain the various elements of generalized measurement system with a neat sketch.	Understand	1
Part - C (Problem Solving and Critical Thinking Questions)			
1	What is meant by statistical analysis of random errors? Explain the terms involved in it.	Remember	1
2	With the help of a suitable example, explain the functional description of various elements of a generalized measuring system.	Understand	1
3	a) Classify measuring instruments. b) What are the desired, modifying and interfering inputs for a measurement system? Give examples for each of these quantities. What is the influence of these on the final output?	Understand	1

4	Explain the dynamic response characteristics of first order instruments to step, ramp and sinusoidal inputs.	Understand	1
5	a) Differentiate between accuracy and precision. b) How do second order instruments respond to ramp input?	Remember	1
6	a) Distinguish between direct and indirect methods of measurement with suitable examples. b) Discuss propagation of uncertainties in measurement systems.	Remember	1
7	Elaborate on the procedure adopted for calibrating instruments.	Understand	1
8	With suitable examples, explain how flow measuring instruments are calibrated by the primary and secondary calibration methods.	Understand	1
9	Briefly discuss on calibration of temperature measuring devices with suitable examples.	Understand	1

UNIT - II
MEASUREMENT OF DISPLACEMENT, MEASUREMENT OF TEMPERATURE, MEASUREMENT OF PRESSURE

Part – A (Short Answer Questions)

1	Define the term transducer.	Remember	2
2	What is meant by loading?	Remember	2
3	Compare a primary transducer with secondary transducer.	Understand	2
4	Give examples for active and passive transducers.	Remember	2
5	What is an elastic transducer?	Remember	2
6	Differentiate analog and digital transducers.	Remember	2
7	What is an electric transducer?	Apply	2
8	What is a mechanical transducer?	Remember	2
9	What is meant by displacement measurement?	Understand	2
10	List various transducers used for displacement measurement.	Understand	2
11	State the basic principle behind a resistance potentiometer.	Understand	2
12	List three areas where temperature measurement is important.	Understand	2
13	Define temperature.	Remember	2
14	Explain the basic principle on which the bimetallic thermometer works.	Remember	2
15	List the common metals used in bimetallic strips.	Remember	2
16	What is a pressure thermometer?	Remember	2
17	What are the limitations of thermistor?	Remember	2
18	What is a thermocouple?	Remember	2
19	What is a thermopile?	Understand	2
20	What are pyrometers?	Understand	2
21	State two limitations of a total radiation pyrometer.	Understand	2
22	List a few applications of pressure measurement.	Remember	2
23	Differentiate atmospheric pressure and absolute pressure.	Understand	2
24	Differentiate gauge pressure and vacuum pressure.	Understand	2
25	List two instruments used to measure low pressure.	Understand	2

Part - B (Long Answer Questions)

1	Discuss the following transducers with respect to their construction, working and characteristics: a) Piezo-electric b) Capacitance c) Ionization	Understand	2
2	Explain the calibration procedure for inductive transducer.	Remember	2
3	a) Explain the working principle, construction and characteristics of Linear Variable Differential Transformer (LVDT). b) A platinum resistance thermometer has a resistance of 140.5 Ω and 100.0 Ω at 100° and 0° respectively. If its resistance becomes 305.3 Ω when it is in contact with a hot gas, determine the temperature of gas. Take the temperature coefficient of platinum as 0.0039°C ⁻¹ .	Understand	2
4	a) List electrical transducers for measurement of linear and angular displacement. b) Explain the construction and working of a photo-electric transducer.	Understand	2
5	Design a measurement system for displacement measurement using LDR (Light dependent resistor) as sensor.	Understand	2
6	Explain the principle of working of a pyrometer. With the help of a neat sketch, explain a pyrometer and state its advantages of the same.	Understand	2
7	a) Explain the temperature measurement by thermocouples. b) Explain the temperature measurement by resistance thermometers.	Remember	2
8	Explain the use of thermocouples for the measurement of average temperature of a room.	Remember	2
9	a) Distinguish between RTD and Thermistor. b) State the laws of thermocouples. How are the laws useful in construction of thermocouple thermometers?	Remember	2
10	a) Differentiate between rare metal thermocouples and base metal thermocouples. b) Why protection is needed for a sensing element?	Understand	2
11	With the help of line diagrams, explain the construction, working and advantages of thermal conductivity gauges.	Remember	2
12	With the help of a suitable diagram, explain the construction, working and principle features of bourdon tube pressure gauge.	Understand	2
13	a) Explain the working principle of diaphragm gauge with a neat diagram. b) State the advantages and disadvantages of diaphragm gauge.	Understand	2
14	a) Explain the working principle of manometers for pressure measurement. b) List out various types of manometers used for pressure measurement and discuss their specific characteristics.	Understand	2
15	How do you measure the pressure with the help of U-tube manometer and micro-manometer?	Understand	2
16	a) What is the basic principle in thermal conductivity gauge? Explain the working principle of thermal couple type conductivity gauge. b) A McLeod gauge having V = 200 cm ³ and a capillary diameter of 2 mm is used to measure the gas pressure. What will be the pressure of the gas corresponding to a capillary of 4 cm?	Remember	2
17	Explain the construction and working principle of Ionization pressure gauge.	Remember	2
18	a) Explain absolute, gauge and vacuum pressure b) Explain with the help of suitable sketches, the difference between a Bellow gauge and a diaphragm gauge for pressure measurement.	Understand	2
19	Describe the construction, theory and applications of different types of Diaphragm pressure gauges.	Understand	2
20	Explain the construction, working principle and features of Pirani thermal conductivity gauge.	Remember	2

21	Explain how a resistance potentiometer is used to measure displacement.	Understand	2
22	Briefly discuss on a differential transformer being used for measuring displacement.	Understand	2
23	Explain the working of a helix and spiral bimetallic thermometer.	Remember	2
24	What are RTDs? On what basic principle do they work? Explain with diagram one of the RTDs.	Understand	2
25	What is a thermistor? How is it used for temperature measurement?	Understand	2

Part – C (Problem Solving and Critical Thinking)

1	Explain how a thermocouple is used to measure temperature.		
2	State and explain the three laws of thermocouples.	Remember	2
3	Explain the working of a total radiation pyrometer.	Understand	2
4	Explain the working of an optical pyrometer.	Understand	2
5	How is a dead weight tester used to calibrate pressure measuring devices?	Understand	2
6	Explain how a manometer is used to measure pressure.	Understand	2
7	Explain the working of a bourdon tube pressure gauge.	Remember	2
8	How an elastic diaphragm gauge is used to measure pressure?	Remember	2
9	Explain the bellows gauge used to measure gauge pressure.	Remember	2
10	Explain the bellows arrangement used to measure differential pressure.	Remember	2
11	How can a strain gauge be used to measure pressure?	Remember	2
12	Explain the Mcleod vacuum gauges used for pressure measurement and its limitations.	Understand	2
13	Explain the Pirani-gauge and the thermocouple type conductivity gauge. List their merits and limitations.	Remember	2
14	Explain the working of an ionization gauge to measure pressure.	Understand	2
15	Explain how a bulk-modulus pressure gauge is used to measure pressure.	Understand	2

UNIT-III (I MID)

MEASUREMENT OF LEVEL, FLOW MEASUREMENT

Part - A (Short Answer Questions)

1	What is liquid level?	Remember	3
2	What is the difference between direct and indirect liquid level measuring devices?	Understand	3
3	Explain the basic principle behind electric liquid level sensors.	Understand	3
4	Why flow measurement is important?	Understand	3
5	What are secondary or rate meters?	Understand	3
6	On what basic principle does an obstruction meter work?	Understand	3
7	Where are magnetic flow meters used?	Remember	3
8	What is an ultrasonic flow meter?	Remember	3
9	Define Velocity	Understand	3
10	Write the two kinds of velocity	Remember	3
11	State any one linear velocity transducer	Understand	3

Part – B (Long Answer Questions)

1	What is the principle of working of a magnetic flow meter? What are its advantages over other types of flow meters?	Understand	3
2	a) Describe the construction of bubbler level indicator. b) Explain the use of rotameter for flow measurement.	Remember	3

3	a) Explain the working principle of ultrasonic flow meter. b) Explain the construction and working principle of turbine flow meter with a neat sketch. State its advantages and limitations.	Remember	3
4	With the help of a neat diagram, explain the construction, working and special features of Laser Doppler anemometer.	Understand	3
5	a) Enumerate the principle of operation, construction details, advantages and limitations of rotameter. b) List out the advantages and disadvantages of indirect method level measurement.	Understand	3
6	Describe in detail with neat sketches: a) Hook level indicator b) Turbine flow meter c) Cryogenic fuel method	Understand	3
7	Explain in detail with neat sketches: a) Bubbler level indicator b) Ultrasonic level method c) Capacitive level method	Understand	3
8	Distinguish between the direct and indirect modes of level measurement. Discuss in brief about the methods.	Remember	3
9	Explain the principle of operation of Hot wire anemometer.	Remember	3
10	List the various equipments for measurement of flow. Discuss each one of them in brief.	Remember	3
11	Explain any one float operated liquid level gauge.	Remember	3
12	Explain any one purge system to measure liquid level.	Understand	3

Part – C (Problem Solving and Critical Thinking)

1	Explain a capacitive liquid level sensor used to measure liquid level.	Remember	3
2	Explain a device using a float – rheostat to measure liquid level.	Understand	3
3	How can gamma rays be used to measure liquid level?	Understand	3
4	Explain the construction and working of an orifice meter.	Understand	3
5	Explain the construction and working of a flow nozzle.	Understand	3
6	How is a venture flow meter used to measure flow?	Remember	3
7	List the applications, advantages and limitations of a flow nozzle and venture flow meter.	Remember	3
8	Describe the working of a rotameter.	Remember	3
9	How flow rate is measured using a pitot tube?	Remember	3
10	Explain the working of a magnetic flow meter.	Remember	3
11	Explain the ultrasonic flow meter using the travel time difference method.	Understand	3
12	Explain the ultrasonic flow meter using the oscillating loop system.	Remember	3

UNIT-III (II MID)

MEASUREMENT OF SPEED, MEASUREMENT OF ACCELERATION AND VIBRATION

Part - A (Short Answer Questions)

1	State any three mechanical tachometers used to measure angular velocity	Understand	3
2	State the basic principle behind tachogenerators	Remember	3
3	Write the list of various contactless electrical tachometers	Understand	3
4	Define Vibration	Remember	3
5	What is piezo – electric effect?	Remember	3
6	State the basic principle on which a seismic displacement sensing accelerometer works	Remember	3

7	State the basic principle on which a strain gauge accelerometer works	Remember	3
8	Write various instruments which are used for measuring vibrations	Remember	3
9	Write any three measurement devices for measurement of linear velocity	Remember	3
Part – B (Long Answer Questions)			
1	Explain with neat sketch the working of moving magnet type and moving coil type velocity transducer	Understand	3
2	Explain with neat sketch the working of slipping clutch and centrifugal tachometer	Understand	3
3	Explain with neat sketch the working of vibrating reed and drag cup tachometer	Understand	3
4	Explain with neat sketch the working of commutated capacitor tachometer	Understand	3
5	Explain with neat sketch the working of DC and AC Tachogenerator	Understand	3
6	Explain with neat sketch the working of Inductive pickup and stroboscope tachometer	Understand	3
7	Explain with neat sketch the working of photo electric and capacitor tachometer	Understand	3
8	Explain with neat sketch the working of piezo-electric accelerometer	Understand	3
9	Explain with neat sketch the working of linear and rotational seismic displacement sensing accelerometer	Understand	3
10	Explain with neat sketch the working of strain gauge accelerometer	Understand	3
11	Explain with neat sketch the working of capacitance accelerometer	Understand	3
12	Explain with neat sketch the working of LVDT – accelerometer	Understand	3
13	Explain with neat sketch the working of vibration measurement using stroboscope	Understand	3
Part – C (Problem Solving and Critical Thinking)			
1	Explain the turbine type anemometer.	Remember	3
2	Explain the construction and working of a hot wire anemometer.	Remember	3
3	Explain with neat sketch the working of revolution counter and timer	Understand	3
4	Explain with neat sketch the working of Tachoscope	Understand	3
5	Explain with neat sketch the working of hand speed indicator	Understand	3
6	Explain with neat sketch the working of variable induction accelerometer	Understand	3
7	Explain with neat sketch the working of reed type vibrometer	Remember	3
UNIT-IV			
STRESS STRAIN MEASUREMENTS, MEASUREMENT OF HUMIDITY, MEASUREMENT OF FORCE, TORQUE AND POWER.			
Part – A (Short Answer Questions)			
1	Define strain	Remember	4
2	Define strain gauge	Remember	4
3	What is Poisson's ratio?	Remember	4
4	What is gauge factor?	Remember	4
5	What is bonded strain gauge?	Remember	4
6	What is gauge rosette?	Remember	4
7	What is self temperature compensation?	Remember	4
8	List the materials used for fine wire strain gauges	Remember	4
9	What is piezo-resistivity?	Remember	4

10	Definehumidity	Remember	4
11	Define dry air	Remember	4
12	What is moist air?	Remember	4
13	Define saturated air	Remember	4
14	What is absolute humidity?	Remember	4
15	What is relative humidity?	Remember	4
16	Definehumidity ratio	Remember	4
17	What is percentage humidity?	Remember	4
18	What is wet bulb depression?	Understand	4
19	Definedew point temperature	Understand	4
20	Defineforce	Understand	4
21	Definetorque	Understand	4
22	Definepower	Remember	4
23	What is the principle of mechanical torsion meter	Remember	4
24	What is the principle of electrical torsion meter	Remember	4
25	What is the principle of optical torsion meter	Remember	4
Part – B (Long Answer Questions)			
1	Discuss briefly on the various bonded strain gauges	Understand	4
2	Discuss briefly on the surface preparation and bonding techniques for mounting bonded strain gauges	Understand	4
3	Discuss the essential characteristics required for the backing material of a bonded strain gauge	Understand	4
4	Discuss the procedure to mount a strain gauge with paper backing on the surface under study.	Understand	4
5	Explain one method of temperature compensation using an adjacent arm compensating gauge	Remember	4
6	Explain how a sling psychrometer is used to determine the dry and wet bulb temperatures	Understand	4
7	Explain the working of any one of the absorption hygrometers	Understand	4
8	Explain how a dew point meter is used to measure the dew point temperature	Understand	4
9	Explain the details of a pendulum scale with a suitable diagram	Understand	4
10	Discuss briefly on an unequal arm balance	Remember	4
11	Explain with a diagram a pendulum scale of multi lever type	Remember	4
12	Explain the method of measuring force using a strain gauge load cell	Remember	4
13	Explain how hydraulic load cells are used to measure force	Remember	4
14	Explain the method of measuring force using a pneumatic load cell	Understand	4
15	Explain briefly how a stroboscope is used to measure torque	Understand	4
16	Explain the measurement of torque by optical torsion meter	Understand	4
17	Discuss briefly the measurement of torque using slotted discs	Understand	4
18	Write about strain gauges on rotating shafts	Understand	4
19	Explain with a neat diagram, the working of a Prony brake for estimating power	Understand	4
20	Discuss briefly on fluid friction dynamometers	Understand	4

21	Explain how an Eddy current dynamometer works	Understand	4
22	Discuss briefly on d. c. cradled dynamometer	Understand	4
23	Explain how a flash light torsion dynamometer works with suitable diagram	Understand	4
24	Write the types of dynamometers and Enumeratethe examples for absorption dynamometers	Understand	4
25	Explain driving and transmission dynamometers	Understand	4

Part – C (Problem Solving and Critical Thinking)

1	Compare positive strain with negative strain	Remember	4
2	Enumerate what does it indicate if a strain gauge has a low gauge factor?	Understand	4
3	Explain how an unbounded strain gauge is used to measure strain	Understand	4
4	Discuss the advantages and disadvantages of unbounded strain gauges	Understand	4
5	Differentiate the n – type and p – type sensing elements of a semi – conductor strain gauge	Understand	4
6	Why the humidity has to be measured	Remember	4
7	What is the difference between weight and mass?	Remember	4
8	What is the purpose of providing backing for bonded strain gauges?	Remember	4
9	What is temperature compensation with respect to strain gauges?	Remember	4
10	What is a proving ring? How is it used to measure force?	Remember	4

**UNIT-V
ELEMENTS OF CONTROL SYSTEMS**

Part - A (Short Answer Questions)

1	Define a system.	Remember	5
2	Define a control system	Remember	5
3	Write the elements of a control system	Remember	5
4	Define a controlled variable	Remember	5
5	Define an indirectly controlled variable	Remember	5
6	Define command	Remember	5
7	Define reference input	Remember	5
8	Define actuating signal	Remember	5
9	Define disturbance	Remember	5
10	Define system error	Remember	5
11	Write the classification of control systems	Understand	5
12	Define open-loop control system.	Remember	5
13	Write the elements of open-loop control system	Remember	5
14	Sketch the open-loop control system.	Remember	5
15	Writethe advantages of open-loop control system	Understand	5
16	Write the limitations of open-loop control system	Understand	5
17	Writetwo examples for open-loop control system	Understand	5
18	Define closed-loop control system.	Understand	5
19	Write the elements of closed-loop control system	Remember	5
20	Sketch the closed-loop control system.	Remember	5

21	Write the advantages of closed-loop control system	Remember	5
22	Write the limitations of closed-loop control system	Remember	5
23	Write two examples for closed-loop control system	Remember	5
24	Define Block diagram	Remember	5
25	Define Stability	Remember	5
Part - B (Long Answer Questions)			
1	Explain the elements of control system	Understand	5
2	Explain four examples of control system applications	Remember	5
3	How control systems are classified?	Understand	5
4	Explain open-loop control system with neat sketch	Understand	5
5	Explain briefly two examples of open-loop control systems	Understand	5
6	Explain closed-loop control system with neat sketch	Understand	5
7	Explain briefly an example of closed-loop control systems	Remember	5
8	Explain advantages and disadvantages of open-loop control system	Remember	5
9	Explain advantages and disadvantages of closed-loop control system	Remember	5
10	Explain the characteristics of feedback	Remember	5
11	Explain automatic control system	Remember	5
12	Explain the advantages and limitations of automatic control system	Understand	5
13	Define block diagram and Explain the steps in developing a block diagram	Remember	5
14	Explain with neat sketch the working of pneumatic control systems	Understand	5
15	Explain with neat sketch the working of hydraulic control systems	Remember	5
16	Explain the advantages and disadvantages of pneumatic control systems	Understand	5
17	Explain the advantages and disadvantages of hydraulic control systems	Understand	5
18	Explain the applications of pneumatic control systems	Understand	5
19	Explain the applications of hydraulic control systems	Understand	5
20	Explain with block diagrams any one temperature control system	Remember	5
21	Explain with block diagrams any one speed control system	Remember	5
22	Explain with block diagrams any one position control system	Remember	5
23	Explain the features of servo-mechanism	Remember	5
24	Explain the requirements of control systems	Understand	5
25	Explain the functions of instruments and measuring systems	Understand	5
Part – C (Problem Solving and Critical Thinking)			
1	Differentiate between the open-loop and closed-loop control systems	Remember	5
2	Explain briefly what do you understand by the term 'stability'?	Understand	5
3	Explain with neat diagram open-loop word processor control system	Understand	5
4	Explain with neat diagram closed-loop idle-speed control system	Understand	5
5	Explain the block diagram of the feedback control system	Understand	5
6	Explain how the bandwidth, accuracy, instability, non-linearities, distortion and sensitivity effect the feedback	Remember	5
7	Differentiate between controlled variable and indirectly controlled variable.	Remember	5

8	Differentiate between pneumatic and hydraulic control systems	Remember	5
9	Explain Routh stability criterion	Remember	5
10	Enumerate the deficiencies of Routh's criterion	Remember	5

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