SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
Ramapuram Campus
Faculty of Engineering and Technology

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
18ECO133T-SENSORS AND TRANSDUCERS
UNIT II
MULTIPLE CHOICE QUESTIONS

Topic(1-3)

1. Mutual inductance depends on _____
a) self-inductance
b) self-inductance and coefficient of coupling
c) coefficient of coupling
d) permittivity of air
Ans:b

2. Reluctance of a coil is given by which of the following relation?
a) S = l⁄A
b) S = l⁄μ
c) S = a⁄μA
d) S = l⁄μA
Ans:d

3.Self-inductance depends on _____
a) permeability
b) permittivity
c) plank's constant
d) rydberg constant
Ans:a

4. What is the relation between the self-inductance and the reluctance of a coil?
a) directly proportional
b) inversely proportional
c) no relation
d) constant
Ans:b

5. An inductive transducer measures the variation in _____
a) reluctance
b) resistance
c) capacitance
d) self-inductance
Ans:d

6.Which of the following represents drawback of the inductive transducer for displacement measurement?
a) Act of electromagnetic force of attractions
b) Lower sensitivity
c) Requirement of large displacement
d) None of the mentioned
Ans:a

7.Which of the following represents the application of inductive transducers?
a) Displacement measurement
b) Thickness measurement
c) Both displacement and thickness measurement
d) None of the mentioned
Ans:c

8.Which of the following represents materials used for thickness measurement using inductive transducers?

a) Material should be magnetic in nature
b) Material should be magnetic and conducting
c) Material should be magnetic and non-conducting
d) All of the mentioned
Ans:d

9.For thickness measurement, the material should have constant permeability and resistivity.
a) True
b) False
Ans:a

10.Electrodynamic vibration transducers are based on _____
a) Magnetostriction
b) Electromagnetic induction
c) Self inductance
d) None of the mentioned
Ans:b

11.LVDT is a _ _ _ _ _
a) Active transducer
b) Passive transducer
c) Both a) and b)
d) None of the mentioned
Answer: b

13. Synchro is a rotating device that operates on the same principle as a _ _ _ _ _ _
and produces a set of voltages, correlated to angular position.
a. Transformer principle
b. Faradays principle
c. Lens law

d. Tesla principle
Answer: Transformer principle

14.The size of air-cored transducers in comparison to their iron-cored counter parts is
a.smaller
b.bigger
c.same
d.unpredictable
Answer: B

15.Capacitive transducer operate upon the principle of
a.variation of over -lapping area of plates
b.variation of separation of plates
c.variation of relative permittivity of dielectric material between two plates
d.all of the above
Answer: d

16.A Differential transformer is a
(i).Differential voltage of Two secondary windings of a transformer is varied by positioning the magnetic core through an externally applied force
(ii).is used for Pressure measurement
(iii).is used for Force measurement
(iv).is used for Position measurement.
Choose the correct option
a.(i) only
b.(ii)only
c.(iii) only
d.(i)(ii)(iii)(iv)
Ans:a

17.A Displacement of $\pm 12.5mm$ results in the secondary voltage of 5V in an LVDT.If the secondary voltage is 3.2V,the absolute value of the corresponding displacement is
A.4mm
B.6mm
C.8mm
D.10 mm
Ans:c
Hint:
V1/V2=d1/d2
d2=(V2/V1)*d1

18.Which of the following represents the drawback of the inductive transducer for displacement measurement?
a) Act of electromagnetic force of attraction
b) Lower sensitivity
c) Requirement of large displacement

d) None of the mentioned
Ans:a

19.For measuring the Magnitude as well as direction of displacement using LVDT,it is used in conjunction with
a.an Amplitude modulator with LPF
b.a Phase sensitive demodulator followed by LPF
C.a Twin T network
D.integrator
Ans:b

20.Which of the following represents correct conversion for magnetostrictive transducers?
a) Mechanical energy to magnetic energy
b) Mechanical energy to electrical energy
c) Magnetic energy to electrical energy
d) Mechanical energy to acoustic energy
Ans:a

21.Which of the following represents negative magnetostriction?
a) On increasing stress permeability decreases
b) On decreasing stress permeability decreases
c) On increasing stress conductivity decreases
d) None of the mentioned
Ans:a

22.Which of the following elements shows increase in magnetic flux density on decreasing stress applied?
a) Nickel Iron alloy
b) Nickel
c) Both Nickel and Nickel iron alloy
d) None of the mentioned
Ans:b

23.Which of the following materials shows an increase in permeability with increase in tensile stress?
a) Negative magnetostriction materials
b) Non magnetostriction materials
c) Positive magnetostriction materials
d) None of the mentioned
Ans:C

24.Magnetostrictive transducer can be used to measure _____
a) Force
b) Acceleration
c) Torque
d) All of the mentioned
Ans:d

25.Which of the following represents the use of including additional mass in acceleration transducer?
a) To prevent system response to transverse acceleration
b) To prevent system response to linear acceleration
c) To prevent system response to angular acceleration
d) None of the mentioned
Ans:a

26.Magnetostrictive transducers are more sensitive than piezoelectric transducers.
a) True
b) False
Ans:b

27.Which of the following torque can be measured using magnetostrictive transducers?
a) Large amplitude torque
b) Small amplitude torque
c) Torque of an amplitude
d) Cannot be used to measure torque
Ans:b

28.Which of the following represents correct expression for sensitivity in a magnetostrictive transducer?
a) ΔB
b) $\Delta B/\sigma$
c) σ
d) $\sigma/\Delta B$
Ans:b

29.Magnetostrictive transducers can only be used in static forces.
a) True
b) False
Ans:b

30.Which sensor is used in mobile phones?
a) Capacitive touch sensor
b) Temperature sensor
c) Humidity sensor
d) Weight sensor
Answer: a. Capacitive touch sensor

Topics (4-6)MCQs

1)---------is a modified version of the plunger type sensors.
a)LVDT
b)Strain Gauge
c)Magnetostrictive Transducer
d)Electromagnetic Transducer

2) -------is a differential transformer.
a)LVDT
b)Strain Gauge
c)Magnetostrictive Transducer
d)Electromagnetic Transducer

3) The LVDT's can be designed in various sizes for various ranges from a -------movement of the core.
a) few μm to even 1 mm
b) few μm to even 1m
c) few μm to even 1cm
d) few μm to even 2cm

4) Depending on the choice of the materials the LVDT can be used in a temperature range of------
a) +50 to +1500˚ C
b) +50 to +500˚ C
c) -50 to -1500˚ C
d) -50 to -500˚ C

5)In the inductive transducer, the variation of inductance can often be measured by -----circuits
a) Wheatstone Bridge
b) Kelvin bridge
c)AC bridge
d)DC bridge

6) In LVDT the output voltage induced in a secondary coil is V_{os} = ------
a) -n(dϕ/dt)
b) -2n(dϕ/dt)
c) –n/(dϕ/dt)
d) -2n/(dϕ/dt)

7) In the variable reluctance type inductive transducer, the core is a ----
a) Paramagnetic materials
b) Diamagnetic materials
c**) Ferromagnetic materials**
d) Ferrites

8)In which of the following coil arrangement , the linearity range is extended by proper profiling of the secondary coils?

a) **balanced profile secondaries**
b) balanced over wound linear tapered secondaries
c) over wound linear tapered secondaries
d) balanced linear tapered secondaries

9) In LVDT using ferrite core, the supply frequency may be -------,so that the sensitivity can be ----- to a certain extent.
a) decreased, decreased
b) increased, increased
c) decreased, increased
d) increased, decreased

10)In inductive transducer , the coil is wound on -------
a) Ferrite Core
b**) Iron Powder Cores**
c) Laminated Core
d) air core

11) How many types of synchros are available?
a)2
b)3
c)4
d)5

12)In torque type sensors, when $\theta_1 \neq \theta_2$, the torque produced on the receiver synchro rotor T will be ---
a) $K_t \sin(\theta_1 - \theta_2)$
b**)** $2K_t \sin(\theta_1 - \theta_2)$
c)$K_t \sin(2\theta_1 - 2\theta_2)$
d) $K_t \cos(\theta_1 - \theta_2)$

13)In case of synchro control transformer, the rotor of the receiver unit is usually made ------ to make the air gap uniform.
a)spherical
b)hexagonal
c) circular
d)cylindrical

14)For a parallel plate capacitor the capacitance C_p= ---
a) $\varepsilon\alpha/x$ b) $2\varepsilon\alpha/x$ c) $\varepsilon/\alpha x$ d)$2\ \varepsilon/\alpha x$

15)The parallel plate capacitive sensor is often used in a differential form with --------number of plates .
a)2
b)3
c)4 d)5

16) The field strength H is given by --------

a)nI/l

b)2nI/l

c)nIl

d)2nIl

17) The self inductance L of the coil is given by ------

a)nBa/I

b)2nBa/I

c)nBa/2I

d)nBaI

18) In synchros the stator with windings S_1,S_2 and S_3 are separated by ---degree in space.

a)120

b)30

c)45

d)90

19)In synchros the error voltage is-----

a) proportional to the angular rotational difference of the rotors

b) proportional to the angular rotational difference of the stators

c) inversely proportional to the angular rotational difference of the rotors

d)inversely proportional to the angular rotational difference of the stators

20)In synchros if S_{T1} rotor rotates by θ_1 and S_{T2} by θ_2 then the free SDR rotor would rotate by ------ angle for balancing.

a)(θ_1- θ_2)

b)2(θ_1- θ_2)

c)tan (θ_1- θ_2)

d)tan 2(θ_1- θ_2)

21)The capacitance C_{pd} for a three plate capacitor arrangement is given as ----

a) $\varepsilon\alpha/x$

b) $2\varepsilon\alpha/x$

c) $\varepsilon/\alpha x$

d)2 $\varepsilon/\alpha x$

22)In a parallel plate pair, if the dielectric has a number of layers of dielectric constants with corresponding permittivity as ε_i for thickness x_i then the capacitance C_{pd} will be----

a) $\alpha/(\Sigma x_i/\varepsilon_i)$

b) $2\varepsilon_i\alpha/\Sigma x_i$

c) $\varepsilon_i/\Sigma\alpha x_i$

d)2 $\varepsilon_i/\Sigma\alpha x_i$

23)In the Parallel Plate Capacitive Sensor , when λ increases , the sensitivity factor β -----

a)increases with ε_s

b)decreases with ε_s
c)increases with $2\varepsilon_s$
d) decreases with $2\varepsilon_s$

24) The fringing effects in capacitors can be reduced by --
a)using guard ring
b) increasing the edge length
c)increasing the side area of electrodes
d)increasing the plate length

25)For the cylindrical sensor with the electrode thickness negligible as compared to dielectric thickness ,the capacitance is ----
a) **$C_c = 2\pi\varepsilon l/(\ln(D/d))$**
b) $C_c = \pi\varepsilon l/(\ln(D/d))$
c) $C_c = \varepsilon l/(\ln(D/d))$
d) $C_c = 2\pi\varepsilon l/(\ln(Dd))$

Module II
Topics(7-9)MCQ's

1. Piezoelectric effect is when materials produce electric charges when _____
a) Voltage is applied
b) Mechanical Stress is applied
c) Electric field is applied
d) Magnetic field is applied

2. Piezoelectricity means _____
a) Electric polarization
b) Electric dielectric
c) Pressure electricity
d) Polar dielectric

3. All Piezoelectric materials are Ferroelectric.
a) True
b) False

4. Piezoelectric transducer consists of _____
a) copper rod
b) aluminum wire
c) gold crystal
d) quartz crystal

5. Which transducer measure changes in acceleration, pressure, strain and temperature?
a) Photoelectric transducer
b) Capacitive transducer
c) Piezoelectric transducer

d) Inductive transducer

6. Which of the following transducers measures the pressure by producing emf as a function of its deformation?
a) Photoelectric transducer
b) Capacitive transducer
c) Inductive transducer
d) Piezoelectric transducer

7. What is the piezoelectric effect in a crystal?
a) change in resistance because of temperature
b) change of frequency because of temperature
c) current is developed due to force applied
d) voltage is developed because of mechanical stress

8. Self-inductance depends on _____
a) Permeability
b) Permittivity
c) Plank's constant
d) rydberg constant

9. Basically sound waves are _____
a) Voltage signals
b) Pressure waves
c) Current
d) Radiation

10. Which of the following is not a character of a sensor of a sound wave?
a) Causes no health hazard
b) They are suitable in a harsh environment
c) They are only suitable in cold environment
d) They can be used in corrosive environment

11. Which of the following type sound generators are not possible?
a) Piezo electric
b) Magnetostrictive
c) Both piezo electric and magnetostrictive
d) None of the mentioned

12. Piezo electric materials are well cut for _____
a) Good dimension
b) Good coupling coefficient
c) Compact shape of device
d) Increasing frequency

13. Which of the following quantities cannot be measured by capacitive transducers?
a) Displacement
b) Speed
c) Moisture
d) None of the mentioned

14. Capacitive microphone is an application of _____
a) Capacitive displacement transducer
b) Capacitive moisture transducer
c) Hygrometer
d) None of the mentioned

15. Quartz and Rochelle salt belongs to _____ of piezo-electric material
a) Natural group
b) Synthetic group
c) Natural or Synthetic group
d) Fiber group

16. The capacitance microphone is used for the detection of
a) Heart rate
b) Blood flow
c) Heart sound
d) Foot pressure

17. In a variable capacitor, the dielectric material is generally
a) mica
b) air
c) ceramic
d) electrolyte

18. Sounds of frequency higher than 20,000 Hz which are inaudible to normal human ear are called
a) noise
b) frequency
c) ultrasonic
d) amplitude

19. SONAR is the abbreviation of
a) small navigation and random
b) sky navigation and ranging
c) sun nuclear ranging
d) sound navigation and ranging

20. Ultrasonic waves carry more
a) energy only
b) frequency only
c) heat
d) energy and frequency

21. The wavelength of ultrasonic waves is
a) more than audible sound

b) less than audible sound
c) equal to audible sound
d) greater than light wave

22. Sensor effectiveness depends on _____ parameter
a) Sensitivity
b) Radiation
c) Restively
d) All of the above

23. Sound to electrical energy transducer is called what?
a) microphone
b) AFR
c) Tactile sensor
d) Pellistor

24. Which type of sensor is used to measure the distance between the vehicle and other objects in its environment:
a) Ultrasonic sensor
b) Tactile sensor
c) Motion sensor
d) None of these

25. Certain type of materials generates an electrostatic charge or voltage when mechanical force is applied across them. Such a materials are called
a) Piezoelectric
b) photoelectric
c) thermoelectric
d) photo resistive

26. Piezoelectric transducers are
a) Passive transducers
b) Inverse transducers
c) Digital transducers
d) Pulse transducers

27. Which of the following are piezo electric substances
a) Barium titanate
b) Leda titanate
c) Lead Zirconate
d) Cadmium and Sulphate
i) a,b,d
ii) a,c,d
iii) a,b,c
iv) b,c,d

28. Piezo electric transducers work when we apply _____ to it.
a) Mechanical force
b) Vibrations
c)Illuminations

d) Heat

29. Piezo electric crystal can produce an emf
a) when external mechanical force is applied to i
b) when radiant energy stimulates the crystal
c) when external magnetic field is applied
d) when the junction of two such crystals are heated

30. Self- generating type transducers are _____ transducers.
a) Active
b) Passive
c) Secondary
d) Inverse

PART-B

1.	Write short notes on the type of materials used in Piezoelectric sensor.
2.	Explain the classification of inductive sensors.
3.	Derive relation between inductance and reluctance with neat diagram.
4.	Elaborate on the construction of variable reluctance type transducers.
5.	Compare Electromagnetic & Magnetosrtictive transducer based on its working and applications
6.	Write short note about three types of stator cores used in synchros.
7.	Elaborate on the working principle of magnetostrictive transducer.

PART-C

1.	Explain the working principle of LVDT and its operation under three different cases . List out the applications of LVDT.
2.	Write short notes about working of ultrasonic sensors using appropriate diagrams. Also compute the sensitivity of the device with characteristics.
3.	Explain the effect of thickness in working of capacitive transducers with necessary equation and diagram. Also compare the same with normal capacitive transducers.
4.	Explain in detail with necessary diagrams about electromechanical devices which are used to produce output voltage based on angular position.
5.	Explain how synchros can be used in transmission and error detection with neat diagrams
6.	Identify which effect produces electric polarization by mechanical strain in the crystals. Derive d constant and classify the materials used in piezoelectric effect.