Siddaganga Institute of Technology

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belgaum, Approved by AICTE, New Delhi)

B.H. Road, Tumkur, 572103, Karnataka

Scheme and Solutions

Subject Code:	RISE 28	Subject Title:	**SENSORS & INTERNET OF THINGS**

I hereby certify that
- I don't have any blood relatives appearing for this paper.
- I have written down the scheme and solution myself.

	Dr. RUDRAMURTHY M S
Signature of the Faculty	Name of the Faculty

	Dr. JAYANNA H S
Signature of the Chairperson [BOE]	Name of the Chairperson [BOE]

2020-2021	√		
Academic Year	Odd	Even	Summer
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BE	B.Arch.	MCA	MBA	**M.Tech.**
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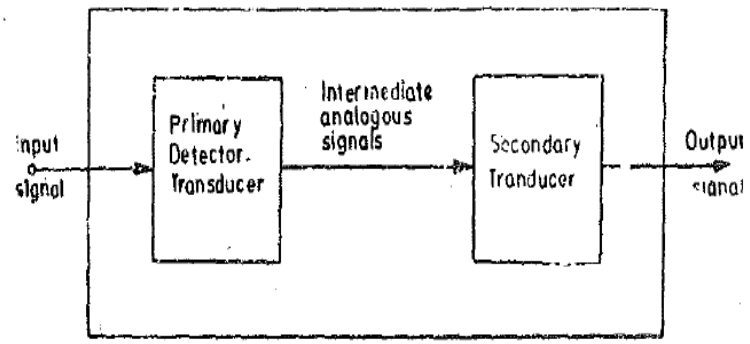
VII SEM
Semester

Total number of pages used

Q.No.	SCHEME AND SOLUTIONS	Marks
Q1A	**Define Transducers. Explain with a neat block diagram. Distinguish between PrimaryTransducers and Secondary Transducers.** **[L2, CO1:PO1] 10 Marks** Solution: A device which converts one form of energy into a form of energy is called transducers. A device which converts physical quantity into an analogous electrical quantity is called transducers. Transducers may be classified as primary transducers and Secondary Transducers. Fig. 25·3 shows a block diagram of a generalized detector transducer stage of a Measurement System.  Fig. 25·3. Block diagram of detector-transducer stage. The primary functions of the detector-transducer stage of a measurement system are : (*i*) sense the measurand properly, and (*ii*) convert the measurand to a format acceptable by the intermediate stage of measurement system (*i.e.*, the signal conditioning stage). The physical phenomenon is first sensed by a detector in most situations converted into an analogous output. This analogous output is then converted into an electrical signal by a secondary transducer. An example, of use of secondary transducer is LVDT along with a Bourdon tube is used for measurement of pressure.	10 M

Please Turn Over

Q.No.	SCHEME AND SOLUTIONS	Marks
	Primary Transducers: These are detectors which sense a physical phenomenon. According to the latest definition of transducers which says that a transducer converts a physical phenomenon to an electrical output. The transducer which falls in this category is thermocouple. The Thermocouple's hot junction senses the radiant heat energy and directly converts it into an analogous electrical output which is a voltage. **Secondary Transducers:** The physical phenomenon is first sensed by a detector in most situations converted into an analogous output. This analogous output is then converted into an electrical signal by a secondary transducer. An example, of use of secondary transducer is LVDT along with a Bourdon tube is used for measurement of pressure	
Q1B	**What is Strain Guage? List the types and briefly discuss the application of strain guage and thermistor.** **[L2, CO1:PO1] 10 Marks**	10 Mark
	Solution: If a metal conductor is stretched or compressed, its resistance changes on account of the fact that both length and diameter of conductor change. Also there is a change in the value of resistivity of the conductor when it is strained and this property is called **piezo resistive effect**. Therefore, resistance strain gauges are also known as **piezoresistive gauges**. the strain gauges are used for measurement of strain and associated stress in experimental stress analysis. Secondly, many other detectors and transducers, notably the load cells, torque meters, diaphragm type pressure gauges, temperature sensors, accelerometers and flow meters, employ strain gauges as secondary transducers. **There are three types of strain gauges: Wirewound, Semiconductor and Foil type strain guage.**	

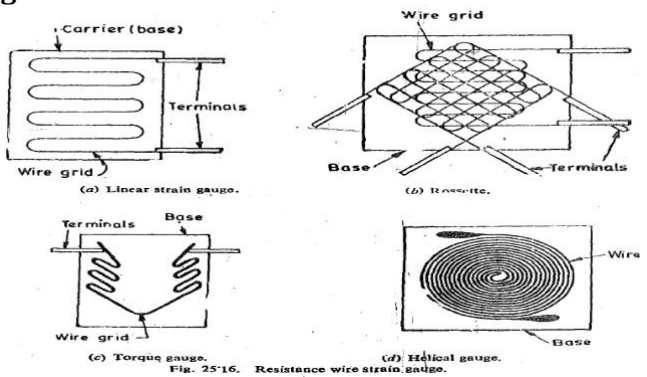


Fig. 25·16. Resistance wire strain gauge.

25·22·3. Applications of Thermistors. The applications of thermistors are :

(*i*) The major application of thermistors is in the field of measurement of temperature. The thermistor's large change of resistance with temperature provides good accuracy and resolution.

A typical thermistor with a resistance of 200 Ω at 25°C and a resistance temperature coefficient of 0·039 Ω/Ω –°C shows a resistance change of 78 Ω/°C.

Thermistors can also be used for :

(*ii*) Temperature compensation in complex electronic equipment, magnetic amplifiers and instrumentation equipment. This is because thermistors possess a negative resistance temperature coefficient and therefore they can be used as compensators in electrical circuits, as in operation of computer circuits which are affected by temperature changes. An increased stability is obtained by using thermistors as compensating devices

(*iii*) Measurement of power at high frequencies. (*iv*) Measurement of thermal conductivity.

(*v*) Measurement of level, flow and pressure of liquids.

(*vi*) Measurement of composition of gases. (*vii*) Vacuum measurements.

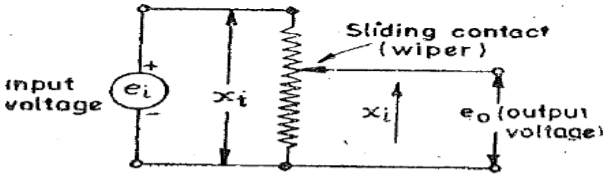
(*vii*) Providing time delay.

Q.No.	SCHEME AND SOLUTIONS	Marks
Q2A)	**Define Thermistor. Differentiate between Negative Temperature Co-efficient (NTC) and Positive Temperature Co-efficient(PTC) Thermistor. A Thermistor has a resistance temperature co-efficient of -8% over a temperature range of 30°C to 55°C. If the resistance of the thermistor is 105 Ω at 30°C, what is the resistance at 40°C.** **[L3, CO1:PO2] 10 Marks** Solution: Thermistor is a contraction of term Thermal Resistors or refers to thermally sensitive resistors. They are essentially semi-conductors which behave as resistors with a high negative temperature co-efficient of resistance. **NTC Thermistor** • NTC stands for Negative Temperature Coefficient. • In NTC thermistor, resistance decreases as its temperature increases as shown in the figure. • NTC thermistors are made using oxides of nickel, cobalt, copper, manganese and other materials. • They are mainly employed for temperature control and measurement applications. • NTC thermistors are used for temperature range from -55^{o}C to 200^{o}C. • Example: SMD KT series NTC thermistor chips manufactured by ATC Semitec Limited **PTC Thermistor** • PTC stands for Positive Temperature Coefficient. • In PTC thermistor, resistance increases as its temperature increases as shown in the figure. • PTC thermistors are made using barium titanate. • They are used to protect electronic circuits from high temperatures. • PTC thermistors are used for temperature range from 0^{o}C to 200^{o}C. • Example: SMD PTC thermistors (TPM series) manufactured by ATC Semitec Limited used as thermal switches Resistance at a temperature of **30 ^{0}C is :** **R_{35} = 105[1-0.08(40-30)] = 21 Ω**	10 M

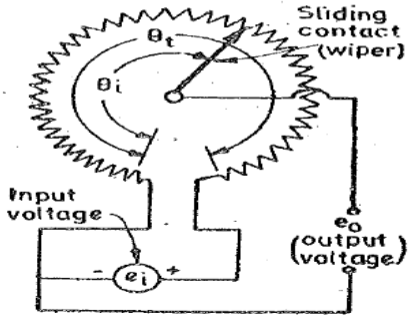
Q.No.	SCHEME AND SOLUTIONS	Marks
Q2B	**What are potentiometers? List the characteristics. How to determine the loading effect of potentiometer? Explain with an example.** **[L2, CO1:PO1] 8 Marks**	10 M

Solution:

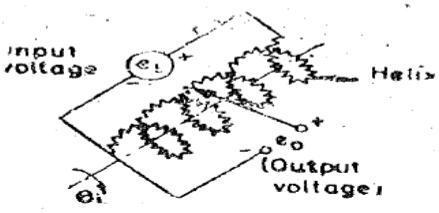
Basically, a resistive potentiometer, or simply a **pot,** (A potentiometer used for the purposes of voltage division is called a **pot**) consists of a resistance element provided with a sliding contact. This sliding contact is called a **wiper.** The motion of sliding contact may be translatory or rotational. Some pots use the combination of the two motions, *i.e.* translational as well as rotational. These potentiometers have their resistive element in the form of helix and thus, are called **helipots.**



(*a*) Translational

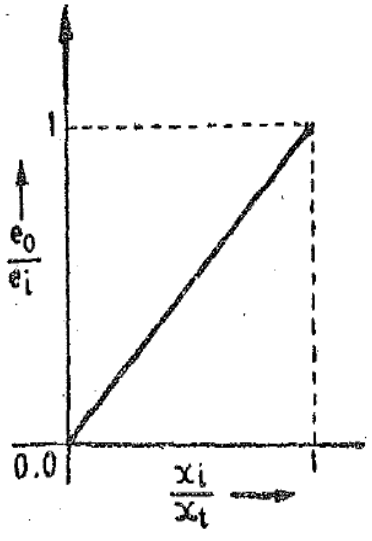


(*b*) Rotational

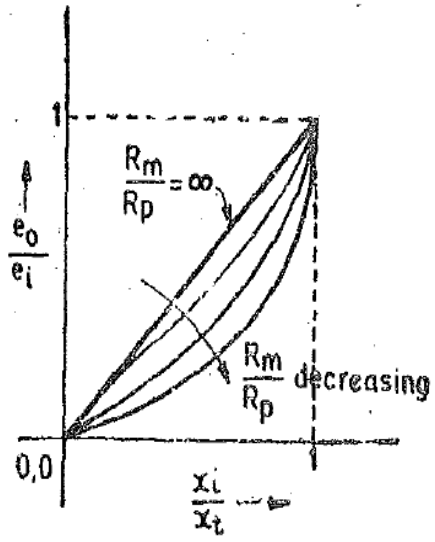


(*c*) Helipot (rotational)

Fig. 25·8. Resistive potentiometers.



(*a*) Unloaded pot



(*b*) Loaded pot

Fig. 25·9. Characteristics of potentiometers.

Sensitivity $S = \frac{\text{output}}{\text{input}} = \frac{e_0}{x_t} = \frac{e_i}{x_t}$

25·17·1. **Loading Effect.** The resistance of the parallel combination of load resistance and the portion of the resistance of the potentiometer is :

$$\frac{(x_i/x_t)\,R_p R_m}{(x_i/x_t)\,R_p + R_m} = \frac{K R_p R_m}{K R_p + R_m} \qquad \ldots(25{\cdot}9)$$

The total resistance seen by the source is :

$$R = R_p(1-K) + \frac{K R_p R_m}{K R_p + R_m} = \frac{K R_p^2 (1-K) + R_p R_m}{K R_p + R_m} \qquad \ldots(25{\cdot}10)$$

$$\therefore \text{ Current } i = \frac{e_i}{R} = \frac{e_i (K R_p + R_m)}{K R_p^2 (1-K) + R_p R_m} \qquad \ldots(25\ 11)$$

The output voltage under loaded conditions is :

$$e_0 = e_i - iR_m(1-K) = \frac{e_i K}{1 + (R_p/R_m)K - (R_p/R_m)K^2} \qquad \ldots(25{\cdot}12)$$

$$= \frac{e_i K}{K(1-K)(R_p/R_m) + 1} \qquad \ldots(25{\cdot}13)$$

The ratio of output to input voltage under loaded conditions is :

$$\frac{e_0}{e_i} = \frac{K}{K(1-K)(R_p/R_m) + 1} \qquad \ldots(25{\cdot}14)$$

The Eqn. 25·14 shows that there exists a non-linear relationship between output voltage e_0 and input voltage e_i. In case $R_m = \infty$, $\frac{e_0}{e_i} = K$.

It is evident from Eqn, 25·14, that as the ratio of R_m/R_p decreases, the non-linearity goes on increasing. This is shown in Fig. 25·9 (*b*). Thus, in order to keep linearity the value of R_m/R_p should be as large as possible. However, when we have to measure the output voltage with a given meter, the resistance of the potentiometer, R_p, should be as small as possible.

$\therefore$ Error = output voltage under load − output voltage under no load

$$= \frac{e_i K}{[K(1-K)(R_p/R_m)+1]} - e_i K = e_i \left[\frac{K^2(K-1)}{K(1-K) + (R_m/R_p)}\right] \qquad \ldots(25{\cdot}15)$$

Based upon full-scale output, this relationship may be written as :

Percentage error

$$\%\epsilon = \left[\frac{K^2(K-1)}{K(1-K) + (R_m/R_p)}\right] \times 100 \qquad \ldots(25{\cdot}16)$$

Except for the two end points where $K = 0$ *i.e.* $x_i = 0$ and $K = 1$ where $x_i = x_t$ the error is always negative. Fig. 25·11 shows a plot of the variation in error with the slider position for different ratios of the load (meter) resistance to the potentiometer resistance.

The error as indicated in Fig. 25·11 is actually negative. Examining Fig. 25·11, the maximum error is about 12 per cent of full scale if $R_m/R_p = 1$. This error drops down to about 1·5 per cent when $R_m/R_p = 10$. For values of $R_m/R_p > 10$ the position of maximum error occurs in the vicinity of $x_i/x_t = 0{\cdot}67$.

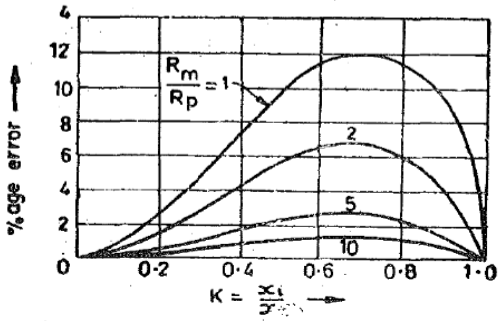


Fig. 25·11. Variation of error due to loading effect of a potentiometer

1. Wire Wound. These use nickel chromium, nickel copper, or some other precious resistance elements. Wire wound potentiometers can carry relatively large currents at high temperatures. Their temperature co-efficient is usually small, is of the order $20 \times 10^{-6}\ \Omega/\Omega\text{-}^\circ\text{C}$ or less and also they are relatively inexpensive. Their resolution is about 0·05 mm and is limited by the number of turns. Multiturn potentiometers using 3 to 10 turn units are used when the potentiometer is required to have close settings.

The interwinding capacitance between turns and between winding and arm, housing etc. limits the use of wire wound potentiometers to low frequencies. The response is limited to about 5 Hz.

2. Cermet. Cermet uses precious metal particles fused into ceramic base. These fused metal particles act as resistance elements. The advantages of using Cermet are large power ratings at high temperatures, low cost and moderate temperature coefficients of the order 100×10^{-6} to 200×10^{-6} $\Omega/\Omega\text{-}^\circ\text{C}$. Cermet is very useful for a.c. applications.

3. Hot Moulded Carbon. The resistance element is fabricated by moulding together a mixture of carbon and a thermosetting plastic binder. Hot moulded carbon units are useful for a.c. applications.

4. Carbon Film. A thin film of carbon deposited on a non-conductive base forms the resistance element. The advantage of carbon film potentiometers is their low cost. Temperature coefficients are upto 1000×10^{-6} °C.

5. Thin Metal Film. A very thin, vapour deposited layer of metal on glass or ceramic base is used as a resistance element. The advantages of this potentiometer are its excellent resistance to changes in environments and use on a.c. The cost is also moderate.

Q.No.	SCHEME AND SOLUTIONS	Marks
Q4A		6 M

Q.No.	SCHEME AND SOLUTIONS	Marks

Figure 1.4: IoT Devices

Q4b Discuss Exclusive Pair Communication model.

[L2, CO2:PO1] 10 Marks 10 M

Solution:

- **Exclusive Pair :** Exclusive Pair is a bi-directional, fully duplex communication model that uses a persistent connection between the client and server. Once the connection is setup it remains open until the client sends a request to close the connection. Client and server can send messages to each other after connection setup. Exclusive pair is a stateful communication model and the server is aware of all the open connections. Figure 1.10 shows the client-server interactions in the exclusive pair model.

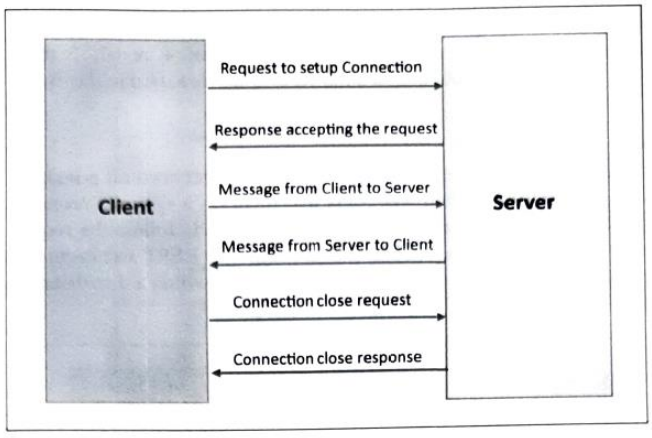
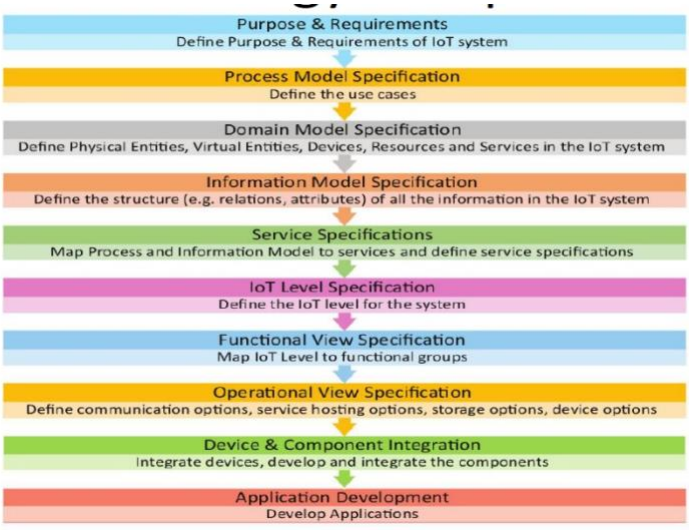
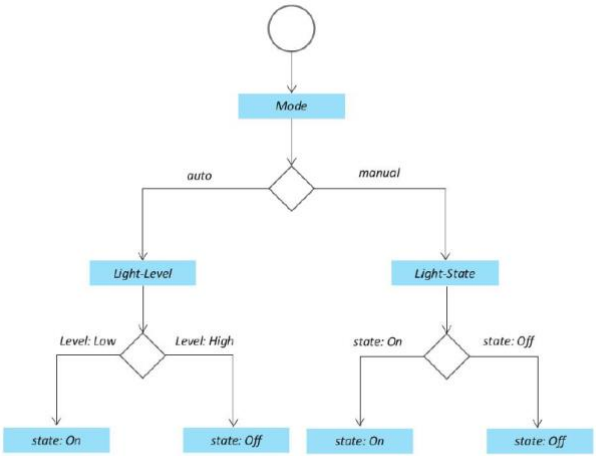


Figure 1.10: Exclusive Pair communication model

Q.No.	SCHEME AND SOLUTIONS	Marks
Q4C	Q4C) Explain the advantages and disadvantages of an IoT. [L2, CO2:PO1] 4 Marks Solution: **Advantages:** • **Efficient resource utilization:** If we know the functionality and the way that how each device work we definitely increase the efficient resource utilization as well as monitor natural resources. • **Minimize human effort:** As the devices of IoT interact and communicate with each other and do lot of task for us, then they minimize the human effort. • **Save time:** As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform. • **Enhance Data Collection:** • **Improve security:** Now, if we have a system that all these things are interconnected then we can make the system more secure and efficient. **Disadvantages:** As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below: • **Security:** As the IoT systems are interconnected and communicate over networks. The system offers little control despite any security measures, and it can be lead the various kinds of network attacks. • **Privacy:** Even without the active participation on the user, the IoT system provides substantial personal data in maximum detail. • **Complexity:** The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.	
	UNIT III	
Q5A)	Provide diagrammatic illustration of steps involved in IoT system design methodology. [L3, CO3:PO2] 10 Marks. Solution:  Explanation 5 Marks and Diagram carries 5 Marks	10 M

Q.No.	SCHEME AND SOLUTIONS	Marks
Q5B	With the neat UML diagram, apply the process specification diagram of an IoT system for home automation. [L3, CO3:PO2] 10 Marks Solution:  Diagram carries 5 Marks and explanation carries 5 Marks Brief explanation to the diagram OR	10 M
Q6A	Discuss any three steps involved in IoT System design methodology. [L3, CO3:PO2] 10 Marks Solution: Following are the steps involved in IoT system design methodology 1. Purpose and Requirements Specification 2. Process Specification 3. Domain Model Specification 4. Information Model Specification 5. Service Specificatins 6. IoT Level Specification 7. Functional View Specification 8. Operational View Specification 9. Device and Component Integration 10. Application Development Explanation to any three steps is sufficient. Each step carries 2 Marks and list carries 4 marks.	10 M
Q6B	With the neat UML diagram, apply the process specification diagram of an IoT system for weather monitoring system. [L3, CO3:PO2] 10 Marks Solution: The purpose of the **weather monitoring system** is to collect data on environmental conditions such as temperature, pressure, humidity and light in an area **using** multiple end nodes. The end nodes send the data to the cloud where the data is aggregated and analyzed.	10 M

Q.No.	SCHEME AND SOLUTIONS	Marks
	UNIT IV	
Q7A)	Explain the main characteristics of python in brief. Develop a python program to compute document statistics. [L3, CO4:PO2] 10 Marks Solution: **Python is Interpreted:** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP. **Python is Interactive:** You can actually sit at a Python prompt and interact with the interpreter directly to write your programs. **Python is Object-Oriented:** Python supports Object-Oriented style or technique of programming that encapsulates code within objects. **Python is a Beginner's Language:** Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games. Characteristics carries 5 marks and Program development carries 5 Marks If the candidate attempt to develop a program to compute statistics of any data for example laboratory data is sufficient and try to give full marks.	10 M
Q7B)	How function overloading is implemented in python? Write a python program to show function overloading. [L3, CO4:PO2] 10 Marks Solution: Overloading, in the context of programming, refers to the ability of a function or an operator to behave in different ways depending on the parameters that are passed to the function, or the operands that the operator acts on. In this article, we will see how we can perform function overloading and operator overloading in Python. Overloading a method fosters reusability. For instance, instead of writing multiple methods that differ only slightly, we can write one method and overload it. Overloading also improves code clarity and eliminates complexity. Overloading is a very useful concept. However, it has a number of disadvantages associated with it. Overloading can cause confusion when used across inheritance boundaries. When used excessively, it becomes cumbersome to manage overloaded functions. Depending on how the function has been defined, we can call it with zero, one, two, or even many parameters. This is referred to as "function overloading". Function overloading is further divided into two types: overloading built-in functions and overloading custom functions. We will look at both the types in the upcoming sections.	10 M

Q.No.	SCHEME AND SOLUTIONS	Marks

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(An autonomous Institute affiliated to VTU, Belgaum, Approved by AICTE, New Delhi)

BH Road, Tumakuru – 572 103, Karnataka.

REMUNERATION BILL FOR SCHEME AND SOLUTIONS

Name :Dr. RUDRAMURTHY M S

Department :Information Science & Engineering

Siddaganga Institute of Technology, Tumkur – 572103

Sl. No.	Branch / Title of the Course	Semester	Subject with Code	Details of Remuneration Claimed	Total Amount Claimed [Rupees]
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