Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

VI SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING) MAKE UP EXAMINATIONS, JUNE 2017

SUBJECT: MEASUREMENTS & INSTRUMENTATION [ELE 3202]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 17 June 2017** **Max. Marks: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- All passive components must be selected to their standard values from the table provided.

1A. What is piezo resistive effect? With appropriate explanations, derive an expression for gauge factor of strain gauges ***(03)***

1B. During the measurement of resistance, the current flowing through a resistor of 0.105 Ω was measured as 30.4A it was discovered later that the ammeter reading was low by 1.2% and the marked resistance was high by 0.3%. Find the true power as a percentage of power that was originally calculated. ***(03)***

1C. With suitable diagrams, explain the concept of Near Field Shielding. Hence, derive the expression for the shielding effectiveness.

A transformer generating primarily a magnetic field is located 10 cm from a shielding structure. The structure is made from a 1 cm thick sheet of copper. Estimate the shielding effectiveness of this structure at 1.5KHz. ***(04)***

2A. Three resistance have ratings as 37 Ω ± 5%, 50 Ω ± 2%, and 100 Ω ± 3%. Determine the magnitude of the limiting error in ohms and the percentage of the total resistances when are connected in:

i) Series
ii) Parallel ***(03)***

2B. Using appropriate reasoning and diagrams, justify the need for the internal ratio arms in a kelvin's double bridge (KDB). Further, Derive an expression for unknown resistance in terms of known standard resistances in the KDB bridge ***(03)***

2C An LVDT with a secondary voltage of 5V has a range of ± 25mm.

i) Find the core movement from the center if the output voltage is -3V
ii) Plot the core positions versus output voltage varying from +3V to -4.5V ***(04)***

3A. Inserting a resistance in series with a capacitor converts a low pass filter to a pole zero circuit as shown in **Fig. 3A**. Determine its mathematical model and specify suitable component values for a pole frequency of 1KHz, a zero frequency of 10 KHz and a dc gain of 0dB. Sketch its magnitude plot. ***(03)***

3B. If $R_1C_1 = R_2C_2$ in the circuit shown in **Fig. 3B**, derive its mathematical model. Specify the component values for a gain of 20dB at 100Hz. ***(03)***

3C. Derive the mathematical model of a band pass active filter depicted in **Fig. 3C**. Also, calculate its lower and upper cut off frequencies along with the voltage amplification factor if the values of the passive components are given below:

$R_1 = R_2 = 10K\Omega$; $R_{f1} = R_{f2} = 100K\Omega$; $R_L = R_H = 10K\Omega$; $C_L = 1\mu F$; $C_H = 1pF$. ***(04)***

4A. Derive the transfer function for second order Sallen-Key filter design working as High pass filter with the help of neat schematic. Also determine, the equations for cut-off frequency and quality factor. ***(03)***

4B. Why is signal isolation important in measurements and instrumentation? With a neat diagram, Explain the working of optical isolation in photo-conductive mode of operation with the help of neat diagram. ***(03)***

4C. For the active amplifier circuit shown in **Fig. 4C**, through appropriate assumptions,

Prove that the output voltage can be expressed as:

$$V_0 = (V_2 - V_1)\left[1 + \frac{R_2}{R_1} + \frac{2R_2}{R_g}\right] + V_{ref}$$ ***(04)***

5A. Explain in detail the measurements of frequency using Lissajous patterns. Mention the factors on which Lissajous patterns are dependent. ***(03)***

5B. With a neat diagram, explain the working of a binary weighted digital-analog converter. For a reference voltage of 5V, create a table of analog voltage output of a 4 bit binary weighted digital-analog converter. Let $R = 100K\Omega, R_f = 400K\Omega$. ***(03)***

5C. With the help of neat block diagram explain working of a Digital Energy Meter focusing on Signal Measurement, it's conditioning as well as it's display. ***(04)***

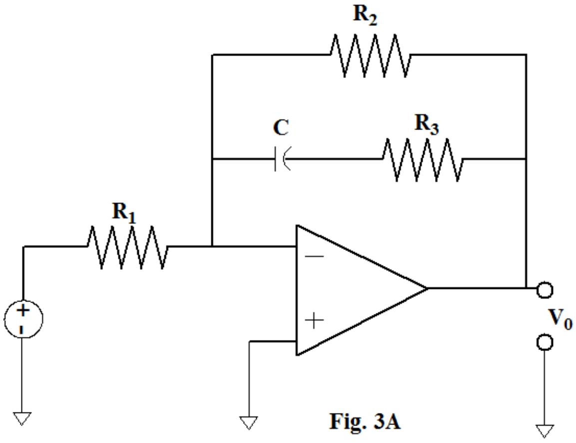

Fig. 3A

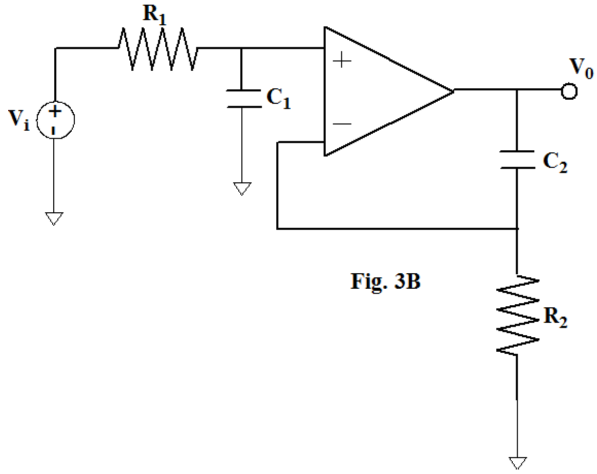

Fig. 3B

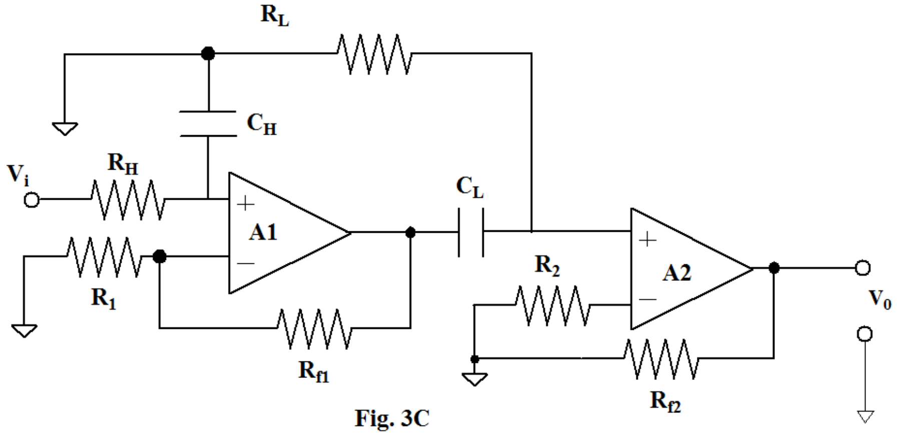

Fig. 3C

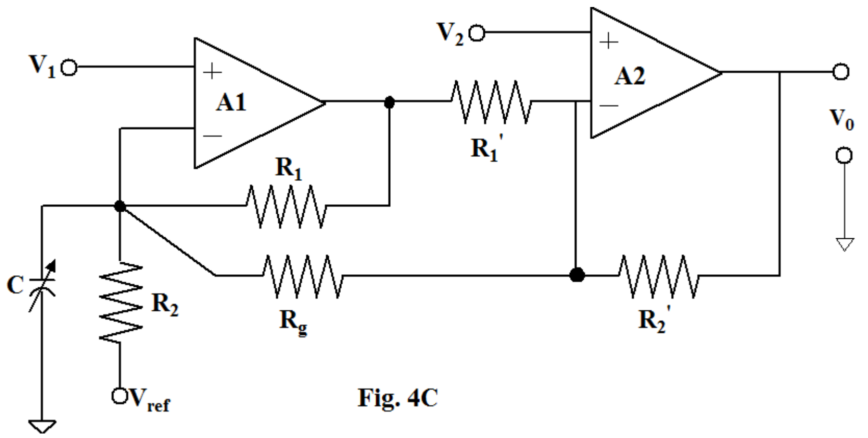

Fig. 4C

Standard Resistor Values (±5%)						
1.0	10	100	1.0K	10K	100K	1.0M
1.1	11	110	1.1K	11K	110K	1.1M
1.2	12	120	1.2K	12K	120K	1.2M
1.3	13	130	1.3K	13K	130K	1.3M
1.5	15	150	1.5K	15K	150K	1.5M
1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

Standard Capacitor Values (±10%)						
10pF	100pF	1000pF	.010µF	.10µF	1.0µF	10µF
12pF	120pF	1200pF	.012µF	.12µF	1.2µF	
15pF	150pF	1500pF	.015µF	.15µF	1.5µF	
18pF	180pF	1800pF	.018µF	.18µF	1.8µF	
22pF	220pF	2200pF	.022µF	.22µF	2.2µF	22µF
27pF	270pF	2700pF	.027µF	.27µF	2.7µF	
33pF	330pF	3300pF	.033µF	.33µF	3.3µF	33µF
39pF	390pF	3900pF	.039µF	.39µF	3.9µF	
47pF	470pF	4700pF	.047µF	.47µF	4.7µF	47uF
56pF	560pF	5600pF	.056µF	.56µF	5.6µF	
68pF	680pF	6800pF	.068µF	.68µF	6.8µF	
82pF	820pF	8200pF	.082µF	.82µF	8.2µF	