B.E Instrumentation & Electronics Engineering 2nd Year 2nd Semester Examination – 2019
Subject: Electrical Measurements

Time: Three hours **Full Marks: 100**

Module	Each module must be answered as per given instruction	Marks
[1]	**Answer *any ten* from this module**	**[10×2]**
(a)	What is the difference between resolution & least count?	
(b)	Define dynamic parameter of measuring instrument with example.	
(c)	Classify electrical measuring instrument on the basis of application.	
(d)	Classifying controlling torque & comment on most efficient one.	
(e)	Why damping torque is necessary?	
(f)	State the name of the instruments those are restricted for only in A.C & only in D.C?	
(g)	State difference between ideal & actual characteristics diode in rectifier instrument.	
(h)	What is the importance of phase angle error in electrical measurement using instrument transformer?	
(i)	Briefly state source of error of moving iron (MI) instrument.	
(j)	State whether moving coil instrument is applicable in both A.C & D.C. State the cause.	
(k)	Define sensitivity of bridge circuit.	
(l)	State the application of ballistic galvanometer.	
(m)	State the source of error in low & high resistance measurement.	
(n)	Draw a simple circuit of a D.C potentiometer.	
(o)	Draw the circuit & phasor diagram an a.c bridge for measurement of self-inductance of high Q-factor coil.	
[2]	**Answer *any two* from this module**	**[2×10]**
(a)	Derive the expression of ratio error & phase angle error for potential transformer with a neat phasor diagram.	[4+4+2]
(b)	What are the sources of error in induction energy meter? State the error nullifying techniques.	[6+4]
(c)	Derive the governing equation of dynamometer type ammeter with a neat sketch of instrument.	[8+2]
[3]	***Answer any two* from this module**	**[2×10]**
a)	Explain measurement of mutual inductance using any suitable a.c bridge with phasor diagram.	[8+2]
b)	Draw a neat sketch of D'Arsonval galvanometer. Explain the dynamic behavior from equation of motion.	[2+8]
(c)	Explain working principle of Megger with a neat sketch. Comment on significance of guard terminal.	[8+2]
[4]	**Answer *any four* from this module**	**[4×10]**
(a)	In a particular instrument the total resistance of the voltage coil is 1 kΩ & the mutual inductance changes uniformly from -150μH at zero deflection to +150μH in full scale, the angle of full scale being 100°. If the potential difference of 200V is applied across the voltage circuit & the current of 5A at power factor of 0.8 is passed through the current coil, what will be the deflection, if the spring coil constant is 5.5×10^{-6} N-m/rad?	[10]
(b)	For a standard Schering bridge data are following: Supply frequency is 50 Hz. 1st arm: having an unknown imperfect capacitance C_1 with unknown equivalent series resistance r_1, 2nd arm: having a capacitance C_2=0.6μF, 3rd arm: having a non-inductive resistance R_3=800 Ω, 4th arm: having non-inductive resistance R_4=4.5kΩ with parallel capacitance C_4=0.4μF. Calculate value of unknown C_1, r_1 & dissipation factor at balance condition.	[10]
(c)	A potential transformer, ratio 1500V/150V, has the following constants: Primary resistance=74.5Ω, secondary resistance=0.76 Ω, primary reactance=46.2 Ω, total equivalent reactance =95 Ω, magnetizing current=0.08A at 0.5 power factor. Calculate: i) phase angle error at no load, ii) load in VA at unity power factor at which the phase angle will be zero, iii) ratio error at no load.	[10]
(d)	In the Wheatstone bridge the values of resistances of various arms are P=1000 Ω, Q=100Ω, R=2005Ω & S=200 Ω. The battery has an emf (E) of 4V & negligible internal resistance. The galvanometer has a current sensitivity (S_i) of 15 mm/μA & an internal resistance (G) of 150 Ω. Calculate the deflection of galvanometer (Θ) & sensitivity of the bridge (S_B). [Assume: current through galvanometer, $I_g=E_0/(R_0+G)$, where E_0 & R_0 are Thevenin equivalent voltage & resistance across galvanometer terminals respectively when galvanometer is open circuited. $\Theta=S_i.I_g$, $S_B=\Theta/\Delta R$].	[10]
(e)	An energy meter is designed to make 120 revolutions of disc for one unit of energy. Calculate the number of revolutions made by it when connected to a load carrying 45 A at 230V & 0.6 power factor for an hour. If it actually makes 400 revolutions, find the percentage of error.	[10]