Roll No.													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST 1

Sem & AY: Odd Sem. 2019-20 | **Date**: 27.09.2019

Course Code: EEE 209 | **Time**: 11:00AM to 12:00PM

Course Name: Electrical and Electronic Measurement and Instrumentation | **Max Marks**: 40

Program & Sem: B.Tech (EEE) & V Sem | **Weightage**: 20%

Instructions:

(i) Read the question properly and answer accordingly.

(ii) Question paper consists of 3 parts.

(iii) *Scientific and Non-programmable calculators are permitted.*

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries three marks. (3Qx3M=9M)

1. List the various characteristics of a measuring instrument.
(C.O.NO. 1) [Knowledge]
2. Classify the different types of Torque in Electromechanical Instruments.
(C.O.NO.2) [Knowledge]
3. Formulate the Expression for T_d and Θ for PMMC Instrument.
(C.O.NO.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries eight marks. (2Qx8M=16M)

4. Errors which is the difference between the true value and measured value is the factor that reduces the accuracy of the instrument. Identity and Explain those errors and its minimization which are caused by human, external factors.
(C.O.NO.1) [Comprehension]

5. PMMC Instrument is graded as the instrument of accuracy for DC voltage and current measurement and it cannot measure AC. Discuss with neat diagram, the construction, working and mechanisms required to grade PMMC as accurate DC measuring Instrument. (C.O.NO.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question, Question carries fifteen marks. **(1Qx15M=15M)**

6. A circuit was tuned for resonance by eight different students and the values of resonant frequency in kHz were recorded as 532,548, 543, 535, 546, 531, 543 and 536.Resonance is a special condition when the current is maximum in the circuit and the net reactance of the circuit is zero.

   a) Identify the unknown quantities that could be found from the given data [2M]

   (C.O.NO.1) [Comprehension]

   b) Compute the unknown quantities from the given set of data [13M]

   (C.O.NO.1) [Comprehension]

SCHOOL OF ENGINEERING

Semester: 5th

Course Code: EEE 209

Course Name: Electrical and Electronic Measurement and Instrumentation

Date: 27th Sep 2019

Time: 1 Hour

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1.	CO1	Module 1	3M									3
2.	C02	Module 2		3M								3
3.	C02	Module 2			3M							3
4.	CO1	Module 1				8M						8
5.	CO2	Module 2					8M					8
6.	CO2	Module 2						8M				8
7.	CO1	Module 1				15 M						15
8.	CO2	Module 2					15 M					15
	Total Marks		3	3	3	23	23	8				

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

[I hereby certify that All the questions are set as per the above guidelines.Ms.Ramya K]

Reviewers' Comments

Annexure- II: Format of Answer Scheme

SCHOOL OF ENGINEERING

SOLUTION

Semester: 5th

Course Code: EEE 209

Course Name: Electrical and Electronic Measurement and Instrumentation

Date: 27.09.2019

Time: 11 am – 12 noon

Max Marks: 40

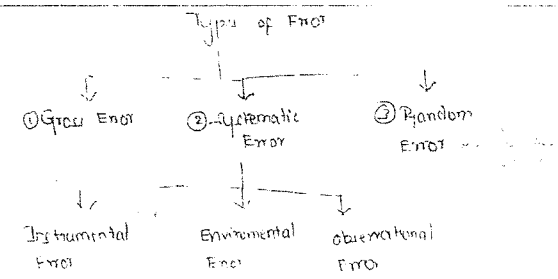
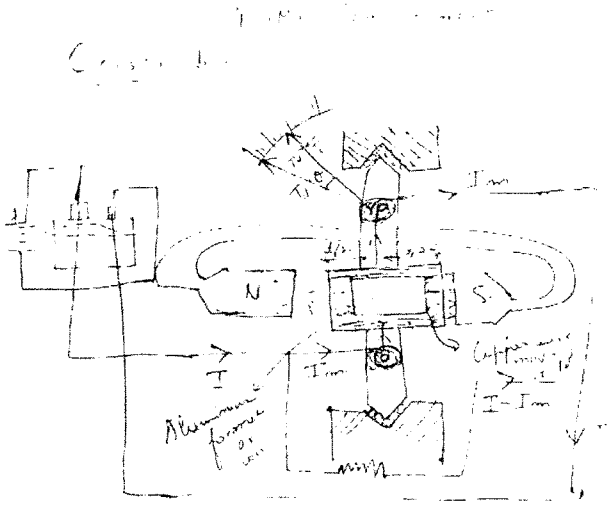
Weightage: 20%

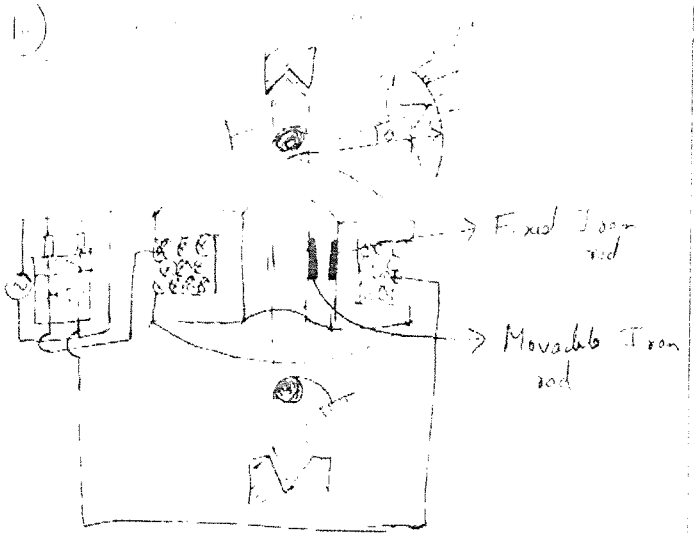
Part A (3Qx 3M =9 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1.	True Value, Static Error, Static Correction, Error Calibration Curve, Accuracy and Precision. , Static Sensitivity, Linearity. Hysteresis, Dead Time, Dead Zone, Resolution	Any 6 must be mentioned, each carries 0.50 marks	3 mins
2.	**Types of Torque** **1. Deflection Torque** – Force required to move the pointer from initial position. **2. Control Torque-** Because of Deflection torque pointer continuously rotate , one more force is required to stop the pointer at some position.	All 3 torque types – 1.50 marks Definition for all 3 – 1.50 marks	3 mins

	3. Damping Torque- Force required to damp the oscillations produced by control torque.		
3.	$T_c = K_c \theta$ At steady state $T_c = T_d$ $K_c \theta = BINA$ $\theta = \frac{BINA}{K_c}$	3 marks	3 mins

Part B (2Q x 8M = 16Marks)

Q No	**Solution**	**Scheme of Marking**	**Max. Time required for each Question**
4.		Errors Types-3 Marks Explanation – 5 Marks	15 mins
5.		PMMC Construction – 2 Marks Working - 2 marks Mechanism of torque production (Control torque & Damping Torque) – 4 marks	15 mins

6.	1.)  	Repulsion Type MI Instrument Construction – 3 Marks Working – 2 Marks Derivation – 3 Marks	15 mins

Part C (1Q x15 M = 15Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
7.	Given: $X_1 = 532, X_2 = 548, X_3 = 543, X_4 = 535, X_5 = 546, X_6 = 531, X_7 = 543, X_8 = 536.$ To find: a) $\bar{X}$ = ? (b) d = ? (c) $\bar{D}$ = ? (d) SD = ? (e) V = ?	Given 1 mark (Not Necessarily Required) To Find – 2 Marks Mean -2 Marks Deviation- 3 Marks Average deviation- 2 Marks Standard Deviation – 3 Marks	20 mins

(a) $\bar{x} = \frac{\sum_{n=1}^{n} x_n}{n} = \frac{532+548+543+535+546+531+543+536}{8}$

$\bar{x} = 539.25$ KHz //.

$d_1 = x_1 - \bar{x} = 532 - 539.25 = -7.25$ KHz

$d_2 = x_2 - \bar{x} = 548 - 539.25 = +8.75$ KHz

$d_3 = x_3 - \bar{x} = 543 - 539.25 = +3.75$ KHz

$d_4 = x_4 - \bar{x} = 535 - 539.25 = -4.25$ KHz

$d_5 = x_5 - \bar{x} = 546 - 539.25 = +6.75$ KHz

$d_6 = x_6 - \bar{x} = 531 - 539.25 = -8.25$ KHz

$d_7 = x_7 - \bar{x} = 543 - 539.25 = +3.75$ KHz

(b) $d_8 = x_8 - \bar{x} = 536 - 539.25 = -3.25$ KHz

(c) Average deviation:

$$\bar{D} = \frac{\sum |d|}{n}$$

$$\bar{D} = 5.75 \text{ KHz}$$

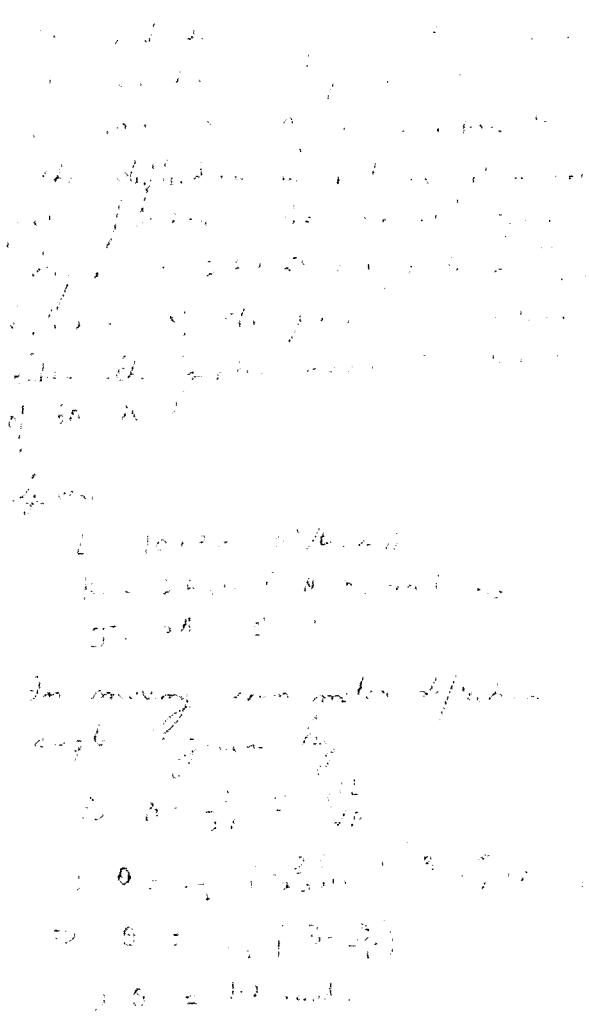
(d) Standard deviation, $\sigma = \sqrt{\frac{\sum d^2}{n-1}}$

$$\sigma = \sqrt{\frac{(-1.25)^2 + (10.75)^2 + (3.75)^2 + (-4.25)^2 + (-9.25)^2}{5-1}}$$

$$\sigma = 6.54 \text{ KHz}$$

(e) Variance (v)

$$v = \sigma^2 = \frac{\sum d^2}{n-1} = (6.54)^2$$

8.		Given – 1 Mark (NOT Necessarily Required) To Find – 2 Marks Θ Value – 13 Marks	20 mins

Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

TEST – 2

Sem & AY: Odd Sem. 2019-20 **Date**: 16.11.2019

Course Code: EEE 209 **Time**: 11:00 AM to 12:00 PM

Course Name: ELECTRICAL AND ELECTRONIC MEASUREMENT AND INSTRUMENTATION **Max Marks**: 40

Program & Sem: B.Tech (ECE, EEE) & V **Weightage**: 20%

Instructions:

I. Read the question properly and answer accordingly.
II. Question paper consists of 3 parts.
III. Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries three marks. (3Qx3M=9M)

1. Summarize the consequences of keeping the secondary of C.T open with the help of conceptual facts and theories. (C.O.NO.3) [Knowledge]
2. Explain the concept of frequency measurement using lissajious figures with the help of an example. (C.O.NO.3) [Knowledge]
3. Draw of block diagram of $3\frac{1}{2}$ digit DVM and discuss the roll over if the DVM is operating in the 10 V range. (C.O.NO.3) [Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each Question carries eight marks. (2Qx8M=16M)

4. A lab technician was conducting an experiment in analog electronics lab using an analog image plotter, without memory, in sweep mode or Y-t mode of operation to observe the amplitude variations of the unknown test signal on the screen with respect to time. But proper steady state waveform wasn't getting displayed on the screen because of some improper settings. In that context discuss the different cases of waveforms as a consequence of improper settings with functional block diagram. (C.O.NO.3) [Comprehension]

5. Measurement of high voltages has always been an arduous task and hence some special types of equipments are used for that purpose. High voltages must be stepped down to a safer level before feeding the measuring meters and protective relays as these are low voltage devices and will get damaged. An equipment was installed in a substation for measurement of high voltages and for overvoltage protection. In that context discuss about the different parts of those types of equipments. (C.O.NO.3) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The Question carry fifteen marks. (1Qx15M=15M)

6. A current transformer with with 5 primary winding turns has a secondary burden consisting of a resistance of 0.16 Ω and an inductive reactance of 0.12 Ω.The primary current is 200 A. The magnetizing current is 1.5 A and the core loss component of current is 0.4 A. The actual transformation ratio is 100.1.

   a) Identify the unknown quantities that could be found from the given data [5M] (C.O.NO.3) [Comprehension]

   b) Compute the unknown quantities from the given set of data [10M] (C.O.NO.3) [Comprehension]

SCHOOL OF ENGINEERING

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Semester: 5th

Course Code: EEE 209

Course Name: Electrical and Electronic Measurement and Instrumentation

Date: 27.09.2019

Time: 11am to 12 pm

Max Marks: 40

Weightage: 20%

Extract of question distribution [outcome wise & level wise]

Q.NO	C.O.NO	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels			Thought provoking type [Marks allotted] Bloom's Levels			Problem Solving type [Marks allotted]			Total Marks
			K			C			A			
1	3	3	3									3
2	3	3		3								3
3	3	3			3							3
4	3	3						8				8
5	3	3					8					8
6	3	3							5	10		15
	Total Marks											40

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must

be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

Annexure- II: Format of Answer Scheme

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

SOLUTION

Semester: 5th

Course Code: EEE 209

Course Name: Electrical and Electronic Measurement and Instrumentation

Date: 27.09.2019

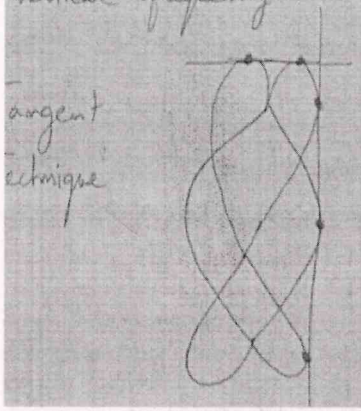
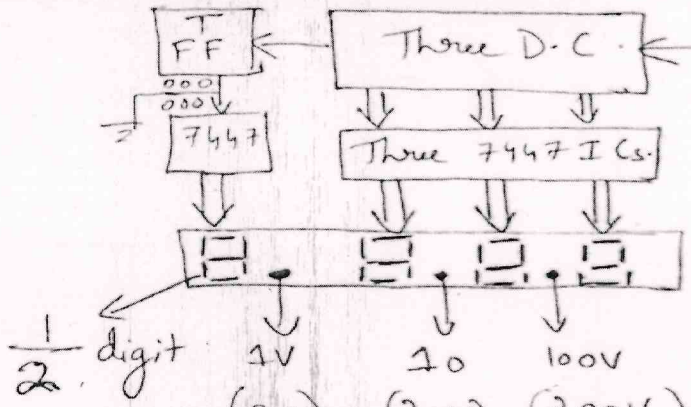
Time: 11am to 12 pm

Max Marks: 40

Weightage: 20%

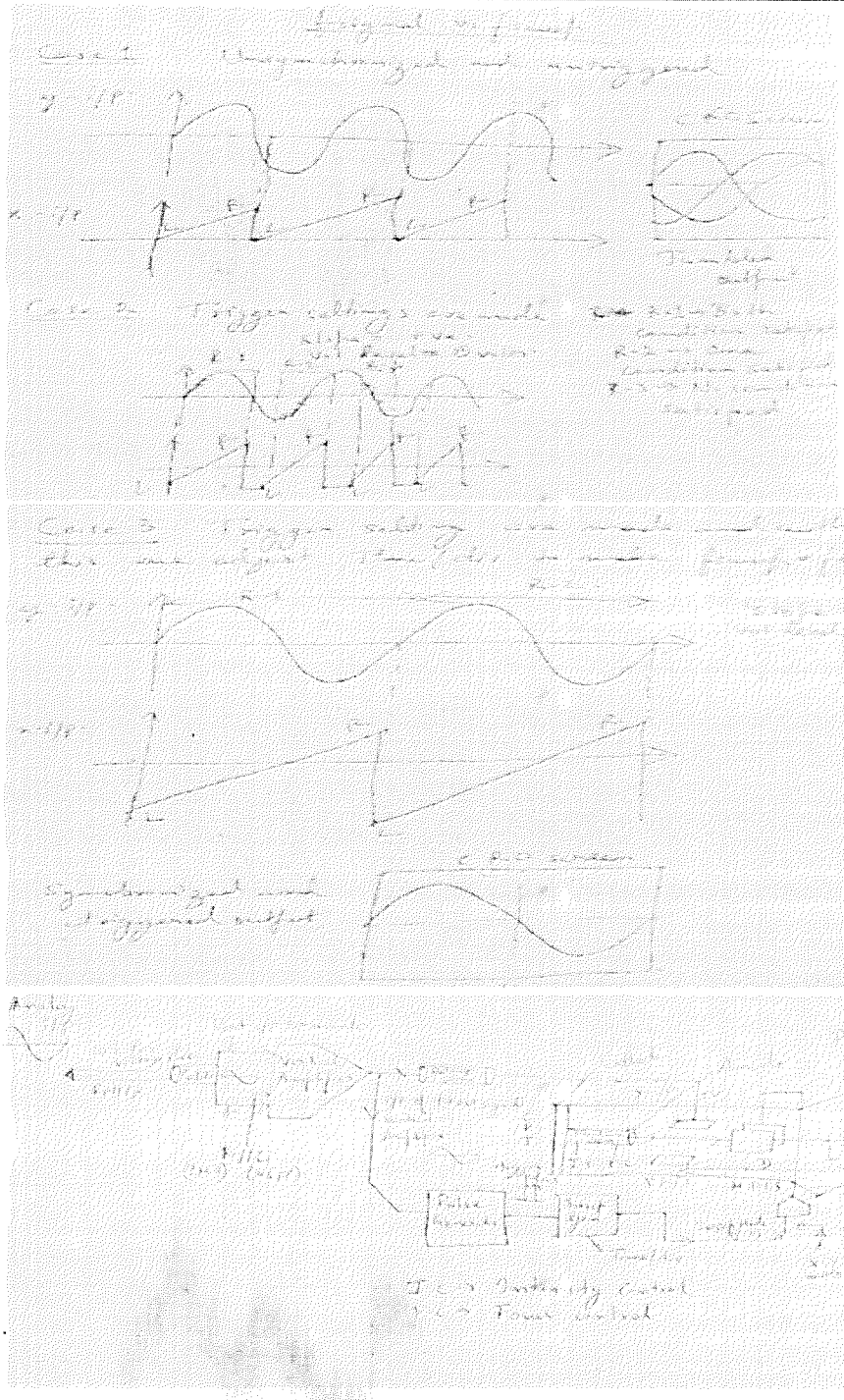
Part A (3Q x 3M = 9Marks)

Q No	Solution	Scheme of Marking	Max. Time required for Question
1	It is very important that the secondary of C.T. should not be kept open. Either it should be shorted or must be connected in series with a low resistance coil such as current coils of wattmeter, coil of ammeter etc. If it is left open, then current through secondary becomes zero hence the ampere turns produced by secondary which generally oppose primary ampere turns becomes zero. As there is no counter m.m.f., unopposed primary m.m.f. (ampere turns) produce high flux in the core. This produce excessive core losses, heating the core beyond limits. Similarly heavy e.m.f.s will be induced on the primary and secondary side. This may damage the insulation of the winding. This is danger from the operator point of view as well. It is usual to ground the C.T. on the secondary side to avoid a danger of shock to the operator. Hence never open the secondary winding circuit of a current transformer while its primary winding is energised.	~~½ marsk for each characteristics~~ 3marks for explenation	5

2	When a CRO is operated in X–Y mode the below given lissajous figure is observed on the screen. The horizontal frequency is 600 Hz. Then what is the vertical frequency.  Tangent technique m_y = 3 peaks m_x = 2 peaks $f_y = 600 \times \frac{2}{3}$ $= 400$ Hz.	~~½ marks for each error~~ 3 marks for example and computation	5
3	 10V range [10×2 min V = 00.01 V Max V = 19.99 V. → 2000 steps × $\frac{10\text{ mV}}{\text{step}}$ = 20V	2 marks for diagram and 1 mark for labelling	5

Part B

(2Q x 8M = 16 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
4		4 marks for waveforms and 4 marks for diagram	15
5	Core – The core of the potential transformer may be of core type or shell type. In a core type transformer, the windings surrounding the core and in the shell type transformer the core surrounded the winding. The shell type transformer designs for low voltage works while the core type transformer is used for high voltage applications.	2 marks for explanation of each part	15

	2. Windings – The primary and secondary windings are placed coaxially for reducing the leakage reactance of the potential transformer. Note Leakage Reactance – All the flux from the primary winding of the transformer is not linked with their secondary windings. The small portion of the flux link with any one of the winding. This portion of the flux is known as the leakage flux. The leakage flux creates the self-reactance in the winding in which they link. The term reactance means the opposition occurs by the circuit element because of the change of the voltage and current. This self-reactance is known as the leakage reactance. In low voltage transformer, the insulation is placed next to the core for reducing the problems of insulation.The single coil is used as the primary winding of the low potential transformer. But in the large potential transformer, the single coil is subdivided into small parts for reducing the insulation between the layer. 3. Insulation – The cotton tape and the cambric materials are used as insulation between the winding of the potential transformer. The compound insulation is not used in low voltage transformer. The high voltage transformer uses oil as an insulation medium. The transformer having a rating higher than 45kVA uses porcelain material as an insulator. 4. Bushing – The bushing is an insulated device through which the transformer is connected to the external circuit. The bushings of the transformer are made of porcelain material. The transformer which uses the oil as an insulating medium uses the oil filled bushing.		

Part C (1Q x 15M =15 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	Given : $N_p = 5$ $Z = 0.16 + j\,0.12\ \Omega = 0.2\angle 36.86^\circ\ \Omega$ $\therefore \delta = 36.86^\circ$, $\sin\delta = 0.6$; $\cos\delta = 0.8$ $I_m = 1.5\ A$ $I_c = 0.4\ A$ $I_p = 200\ A$ $N_s = 100$ To Find : (1) N_c = ? (2) θ = ? Sol : (1) N_c We know, $n = \frac{N_c}{N_p}$ $\therefore N_c = n\,N_p$ To find 'n' ; We know, $I_p = n\,[I_m \sin\delta + I_c \cos\delta]$	5 marks for Identifying the unknown quantities and 10 marks for computation	10

$$100.1 = \eta + \frac{(1.5)(0.6)+(0.4)(0.8)}{I_s}$$

Sec

$$\text{We, } S = \frac{I_r}{I_s}$$

$$\therefore I_s = \frac{I_p}{100.1} = \frac{200}{100.1} = 1.998$$

$$\therefore 100.1 = \eta + \frac{(1.5)(0.6)+(0.4)(0.8)}{1.998}$$

$$\therefore \boxed{\eta = 99.4893} \text{ //}$$

(ii) To find 'θ';

$$\theta = \frac{180}{\pi}\left[\frac{I_m \cos\delta - I_r \sin\delta}{\eta I_s}\right]$$

$$\therefore \frac{180}{\pi}\left[\frac{(1.5)(0.8)-(0.4)(0.6)}{(99.4893)(1.998)}\right]$$

$$\therefore \boxed{\theta = 0.2160^\circ} \text{ //ans}$$

Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20 **Date**: 20 December 2019

Course Code: EEE 209 **Time**: 9:30 AM to 12:30 PM

Course Name: ELECTRICAL AND ELECTRONICS MEASUREMENT AND INSTRUMENTATION **Max Marks**: 80

Program & Sem: B.Tech (EEE) & V **Weightage**: 40%

Instructions:

(i) Read the all questions carefully and answer accordingly.

(ii) Diagrams Should be drawn using Scale and Pencil only.

Part A [Memory Recall Questions]

Answer all the Questions. Each Question carries 2 marks. **(10Qx2M=20M)**

1. Explain why the secondary of CT should not be left open. (C.O.No.3) [Knowledge]
2. Differentiate between CT and PT (C.O.No.3) [Knowledge]
3. Brief any 2 Applications of Resistive Transducer. (C.O.No.4) [Knowledge]
4. List out Natural and Artificial materials used in manufacturing Piezoelectric Transducer. (C.O.No.4) [Knowledge]
5. Comment on the output (E_o) of LVDT when the Arm is moved left and right (C.O.No.4) [Knowledge]
6. Define the differences between Transducer, sensor and actuator. (C.O.No.4) [Knowledge]
7. Classify 2 bridges each which is used for Measurement of R, L and C. (C.O.No.4) [Knowledge]
8. List the types of Possible Errors in Measurements with mentioning one source each. (C.O.No.1) [Knowledge]
9. Define various Torques in Electromechanical Instruments (C.O.No.2) [Knowledge]
10. Distinguish between direct and indirect methods of measurements (C.O.No.1) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 10 marks. **(3Qx10M=30M)**

11. Identify a device that can produce various patterns of voltage at a variety of frequencies and amplitudes and explain it with a neat functional Block Diagram.

(C.O.No.4) [Comprehension]

12. An Instrument is graded as the instrument of accuracy for DC voltage and current measurement and it cannot measure AC. Identify and Explain with neat diagram, the construction, working and mechanisms required to grade that Instrument as accurate DC measuring Instrument. (C.O.No.2) [Comprehension]

13. Identify and Explain with neat Block Diagram the function and operation of an Oscilloscope with advanced trigger, storage, display and measurement features that can store and analyses the signal digitally. (C.O.No.3) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each Question carries 15 marks. (2Qx15M=30M)

14. The self-capacitance of a coil to be measured by Q meter. The first measurement result is f_1=1.5 MHz and C_1=550 pF. The second measurement result is f_2=3 MHz and new value of tuning capacitor is 110pF. With the neat circuit diagram, explain the instrument used to measure the above quantities and

    (i) Identify the unknown quantities [2M] (C.O.No.4) [Comprehension]

    (ii) With the neat circuit diagram, explain the instrument used to measure the above quantities. [7M] (C.O.No.4) [Comprehension]

    (iii) Calculate the unknown quantities in terms of pF and μH. [6M] (C.O.No.4) [Comprehension]

15. A circuit was tuned for resonance by eight different students and the values of resonant frequency in kHz were recorded as 532,548, 543, 535, 546, 531, 543 and 536.Resonance is a special condition when the current is maximum in the circuit and the net reactance of the circuit is zero.

    a) Identify the unknown quantities that could be found from the given data [2M] (C.O.No.1) [Comprehension]

    b) Compute the unknown quantities from the given set of data [13M] (C.O.No.1) [Comprehension]

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C	
1	CO3	3	2M			2
2	CO3	3	2M			2
3	CO4	4	2M			2
4	CO4	4	2M			2
5	CO4	4	2M			2
6	CO4	4	2M			2
7	CO4	4	2M			2
8	CO1	1	2M			2
9	CO2	2	2M			2
10	CO1	1	2M			2
11	CO2	2		10M		10
12	CO3	3		10M		10
13	CO4	4		10M		10
14	CO1	1			15M	15
15	CO4	4			15M	15
	Total Marks		20M	30M	30M	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

SCHOOL OF ENGINEERING

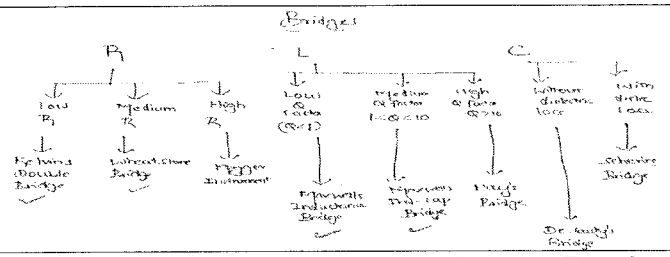
SOLUTION

Semester: Odd Sem. 2019-20
Course Code: EEE209
Course Name: Electrical and Electronics Measurements and Instrumentation
Program & Sem: B.Tech (EEE) & V

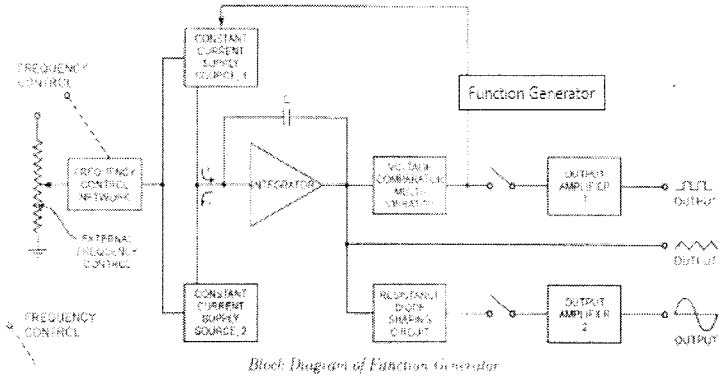
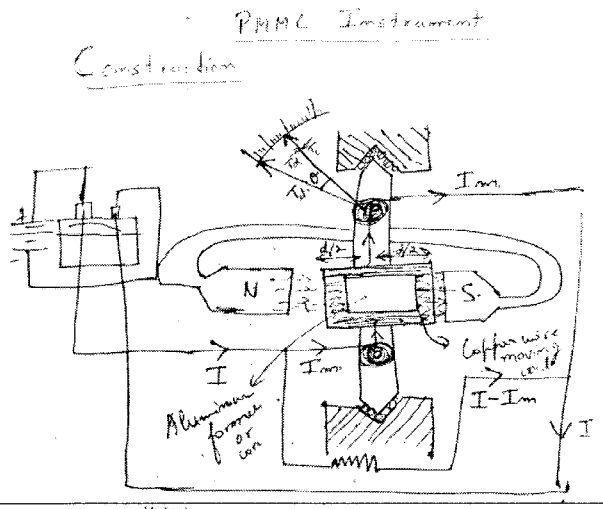
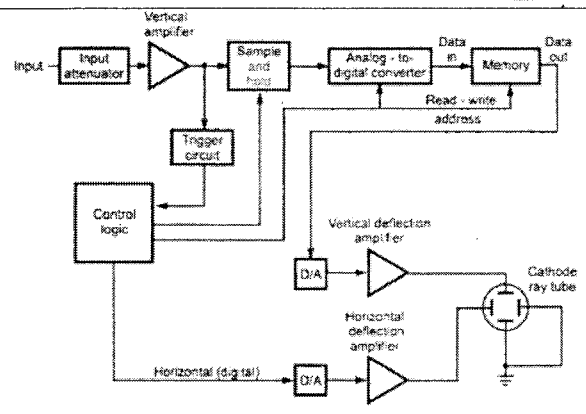
Date: 20 December 2019
Time: 9:30 AM to 12:30 PM
Max Marks: 80
Weightage: 40%

Part A (10Q x 2M = 20Marks)

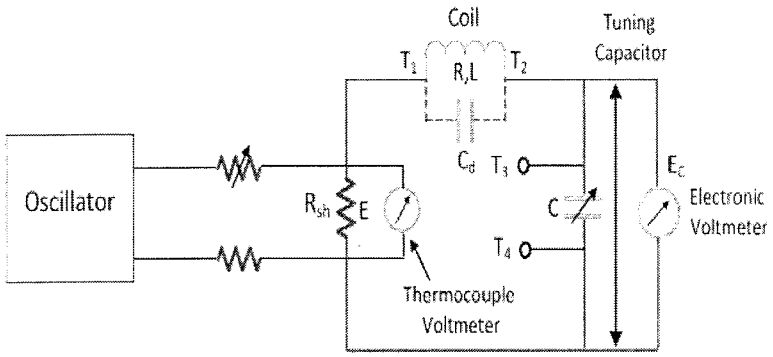
Q No	Solution	Scheme of Marking	Max. Time required for each Question
1	• If the secondary winding is opened and the current flows through the primary windings, then no current flows in secondary and there will be no demagnetizing flux due to the secondary current . • This to high current in primary winding causes excessive heating leading to core losses. This will damage the insulation of winding. • Hence secondary of C.T should never be open. • Instead it should be either shorted or closed with low resistance.	2	5m
2	Any 2 Difference	2	5m
3	• **Strain gauges –** The resistance of their semiconductor material changes when the strain occurs on it. This property of	2	5m

	metals is used for the measurement of the pressure, force-displacement etc. • **Thermistor** – It works on the principle that the temperature coefficient of the thermistor material varies with the temperature. The thermistor has the negative temperature coefficient. The Negative temperature coefficient means the temperature is inversely proportional to resistance.		
4	**Naturally Available Ones:** Quartz, Rochelle salt, Topaz, Tourmaline-group minerals **Artificially manufactures:** are Polyvinylidene difluoride, PVDF or PVF2, Barium titanate, Lead titanate	**2**	**5m**
5	When the arm is moved left output will be positive and negative when moved right	**2**	**5m**
6	All types with one example each should be mentioned	**2**	**5m**
7		**2**	**5m**
8	Direct Methods-Without any Calculations Eg: Scale, Vernier Caliper Indirect Methods-with functions, formulas and calculation Eg: angle measurement by sine Bar	**2**	**5m**
9	**1.Deflection Torque –** Force required to move the pointer from initial position. **2.Control Torque-** Because of Deflection torque pointer continuously rotate , one more force is required to stop the pointer at some position. **3.Damping Torque-** Force required to damp the oscillations produced by control torque.	**2**	**5m**
10			

Part B (3Q x 10M = 30 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
11	 Block Diagram of Function Generator	**Function Generator** Identification- 1 marks Block Diagram-5 Explanation-4	20m
12		**PMMC** Identification- 1 marks Construction – 3 Marks Working – 2 marks Mechanism of torque production (Control torque & Damping Torque) – 4 marks	20m
13	 **Block diagram of digital storage** oscilloscope Operation – Roll Mode, Store Mode, Hold Mode	**DSO** Identification- 1 marks Block Diagram-5 Operation with advantages-4	20m

Part C (2Q x 15M = 30Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
14	 Circuit of Q meter	Identification – 2 Marks Circuit and Explanation-7 marks Calculation-6 Marks	30m
15	Given: $X_1=532, X_2=548, X_3=543, X_4=535, X_5=546, X_6=531, X_7=543, X_8=536.$ To find: a) $\bar{X}=?$ (b) $d=?$ (c) $\bar{D}=?$ (d) $SD=?$ (e) $V=?$. Sol: (a) $\bar{X}=\frac{\sum_{n=1}^{n} X_n}{n} = \frac{532+548+543+535+546+531+543+536}{8}$ $\bar{X}=539.25$ KHz //	Given – 1 mark (Not Necessarily Required) Identification– 2 Marks Mean -2 Marks Deviation- 3 Marks Average deviation- 2 Marks Standard Deviation – 3 Marks Variance-2 Marks	30m

$d_1 = x_1 - \bar{x} = 532 - 539.25 = -7.25\,KHz$

$d_2 = x_2 - \bar{x} = 548 - 539.25 = +8.75\,KHz$

$d_3 = x_3 - \bar{x} = 543 - 539.25 = +3.75\,KHz$

$d_4 = x_4 - \bar{x} = 535 - 539.25 = -4.25\,KHz$.

$d_5 = x_5 - \bar{x} = 546 - 539.25 = +6.75\,KHz$

$d_6 = x_6 - \bar{x} = 531 - 539.25 = -8.25\,KHz$

$d_7 = x_7 - \bar{x} = 543 - 539.25 = +3.75\,KHz$.

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v) $d_8 = x_8 - \bar{x} = 536 - 539.25 = -3.25\,KHz$.

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Office of Controller of Examinations

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Declaration by the Paper-Setter.

I undersigned, Faculty in School of Engineering/ Management/ Law declare the following as Paper setter for the Course Code: EEE 304

Course Name Electrical Drives ✓ for the Evaluation component of **Test 1 /Test 2/Mid Term/End Term/Make-Up**

I do hereby declare that no student is my near relations are pursuing studying in the University in the concerned Semester of the Program.

Date:- 11/12/2019

Signature of Paper-Setter

Name & Designation

Dr. Joshi Manohar V

Question Paper Audited By:

Roll No												

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PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

END TERM FINAL EXAMINATION

Semester: Odd Semester: 2019 - 20
Course Code: EEE 304
Course Name: ELECTRICAL DRIVES
Program & Sem: B.Tech (EEE) & VII (DE-III)

Date: 20 December 2019
Time: 9.30 AM to 12.30 PM
Max Marks: 80
Weightage: 40%

Instructions:

(i) Read the question properly and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.

Part A [Memory Recall Questions]

Answer all the sub Questions. Each sub Question carries 02 marks. (10Qx2M=20M)

1. a) Specify the functions of power modulator (C.O.No.1) [Knowledge]
   b) What are the conventions of speed and torque in Forward Braking and Reverse Motoring Modes? (C.O.No.1) [Knowledge]
   c) Classify the different methods of braking applied to the DC motor (C.O.No.2) [Knowledge]
   d) Type-A chopper has following specifications DC source voltage of 220V, total time period is 20 mSec and Turn off period is 5msec. Calculate output voltage and duty cycle? (C.O.No.2) [Knowledge]
   e) Compute the %slip of 3.2kW, 1440 rpm, 4 poles and 50 Hz three phase induction motor? (C.O.No.3) [Knowledge]
   f) A three phase, 50 Hz, 4 pole induction motor is controlled from a stator voltage regulator. The motor is running at a speed of 1000 rpm. Neglecting the core loss and stator impedance, the % efficiency of the motor will be. (C.O.No.3) [Knowledge]
   g) The maximum value of torque angle (δ) for a synchronous motor is _____ (C.O.No.4) [Knowledge]
   h) What is the value of pull out torque angle of a synchronous motor during braking region? (C.O.No.4) [Knowledge]
   i) What are the different types of drives used in cement industry? (C.O.No.5) [Knowledge]
   j) List out the different operating sections used in paper mills? (C.O.No.5) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each Question carries 07 marks. (4Qx7M=28M)

2. In a class room, the speed of the fan is controlled by a regulator called TRIAC, consider this as an example of an electric drive, identify the various parts of the electric drive and explain the each part in detail.

(C.O.No.1) [Comprehension]

3. A 220V, 10.5A, 1300rpm DC shunt motor is used for wood cutting application and its armature resistance is 0.5Ω. It is required to carve the wood piece at 1000rpm at half the rated torque. The motor is controlled by single phase fully controlled rectifier with an AC source voltage of 230V, 50Hz. It is observed that the motor is running in reverse direction with the rated speed.

(C.O.No.2) [Comprehension]

i) Identify the problem in the rectifier control circuit
ii) Mention the steps to be taken to rotate the motor in positive direction
iii) Compute the firing angle to run the motor at 1000rpm with half rated torque.

4. An induced draft (ID) fan is controlled by stator voltage control. The ID fan motor is having the following specifications 2.8KW, 400V, 50Hz,4 pole, 1370rpm, delta connected squirrel cage induction motor has following parameters referred to the stator: R_s=2Ω, R_r'=5Ω, X_s=X_r'=5Ω, X_m=80Ω,. When driving a fan load it runs at rated speed at rated voltage. Compute the values of motor terminal voltage, current & torque at 1200 rpm.

(C.O.No.3) [Comprehension]

5. A 400 kW, 3-phase, 3.3 kV, 50 Hz, 0.85(lagging) power factor, 4 pole, star connected synchronous motor which is driving low speed compressors has the following parameters: X_s=15 Ω,R_s=0 Ω. Rated field current is 10A. Compute the armature current of the motor and the power factor at half rated torque and rated field current.

(C.O.No.4) [Comprehension]

Part C [Problem Solving Questions]

Answer all the Questions. Each Question carries 08 marks. (4Qx8M=32M)

6. A drive has following equations for the motor and load torques:
$T = (1 - 2\omega_m)$ and $T_l = -3\sqrt{\omega_m}$ obtain the equilibrium points. Analyze results and determine their steady state stability.

(C.O.No.1) [Comprehension]

7. A 230V, 960rpm and 200A separately excited motor has the armature resistance and inductance of 0.02Ω. The Motor is controlled both in motoring and regenerative braking modes by a chopper. The source has the DC voltage of 230V. Assuming continuous conduction
(a) Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm
(b) Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm.

(C.O.No.2) [Comprehension]

8. A 440 V, 50 Hz,970 rpm, 6 pole, star connected, slip ring induction motor has the following parameters: R_s=0.1Ω,R_r'=0.08Ω,X_s=0.3Ω, X_r'=0.4Ω,X_m can be neglected. Stator to rotor turns ratio is 2. The motor speed is controlled by static Krammer drive. The drive is designed for a speed range of 25% below synchronous speed. Maximum value of firing angle is 165^0.

   Compute i) Transformer turns ratio

   ii) Torque for a speed of 780 rpm and $\alpha = 140^0$

   (C.O.No.3) [Comprehension]

9. a) A 1492 kW ,unity power factor,3-phase ,star-connected ,2300 V, 50 Hz, synchronous motor has a synchronous reactance of 1.95 ohm/phase. Compute the maximum torque in N-m which this motor can deliver if it is supplied from a constant frequency source and if the field excitation is constant at the value which would result in unity power factor at rated load. Assume that the motor is of cylindrical rotor type. Neglect all losses.

   (C.O.No.4) [Comprehension]

   b) Classify the drives used in cement industry and explain them in detail.

   (C.O.No.5) [Comprehension]

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END TERM FINAL EXAMINATION

Extract of question distribution [outcome wise & level wise]

Q.NO.	C.O.NO (% age of CO)	Unit/Module Number/Unit /Module Title	Memory recall type [Marks allotted] Bloom's Levels	Thought provoking type [Marks allotted] Bloom's Levels	Problem Solving type [Marks allotted]	Total Marks
			K	C	C	
1	CO 01 CO 02 CO 03 CO 04 CO 05	All modules	20 (4+4+4+4+4)			20
2	CO 01	Module-1		7		7
3	CO 02	Module-2		7		7
4	CO 03	Module-3		7		7
5	CO 04	Module-4		7		7
6	CO 01	Module-1			8	8
7	CO 02	Module-3			8	8
8	CO 03	Module-3			8	8
9	CO 04& CO 05	Module-4			(4+4)	8
	Total Marks		20	28	32	80

K =Knowledge Level C = Comprehension Level, A = Application Level

Note: While setting all types of questions the general guideline is that about 60%

Of the questions must be such that even a below average students must be able to attempt, About 20% of the questions must be such that only above average students must be able to attempt and finally 20% of the questions must be such that only the bright students must be able to attempt.

I hereby certify that all the questions are set as per the above guidelines.

Faculty Signature:

Reviewer Commend:

Format of Answer Scheme

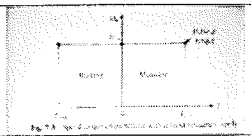
SCHOOL OF ENGINEERING

SOLUTION

Semester: Odd Sem. 2019-20
Course Code: EEE 304
Course Name: Electrical Drives
Program & Sem: B.Tech (EEE) & VII

Date: 20 December 2019
Time: 9.30 AM to 12.30 PM
Max Marks: 80
Weightage: 40%

Part A (10Q x 2M = 20Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
1 a).	Fans,Compressors,ship-propellors	**2M**	**3Min**
1 b).	$T = T_l$	**2M**	**3Min**
1 c).	Dynamic, Regenerative and Plugging	**2M**	**3Min**
1 d).	1561rpm	**2M**	**3Min**
1 e).	0.066	**2M**	**3Min**
1 f).	172.5 N-m	**2M**	**3Min**
1 g).	90^0	**2M**	**3Min**
1 h).		**2M**	**3Min**
1 i).	Raw mill and cement mill drives, kiln drives, crusher drives, waste gas fan drives and compressor drives	**2M**	**3Min**
1 j).	Couch section, press section, dryer section, calendar and reel section	**2M**	**3Min**

Part B (4Q x 7M = 28 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
2	Driving the uphill (angle of inclination), Forward Motoring and Forward Braking, Speed- Torque conventions, Driving in reverse direction, Reverse Motoring and Reverse Braking, Speed- Torque conventions Draw four quadrants of Speed and Torque plane.	• Understanding the multi quadrant operation(2M) • Explanation of the speed-torque conventions while driving from Point A to Part B(Acceleration and Braking)/ Forward Motoring and Forward Braking (2M) • Explanation of the speed-torque conventions while driving from Point B to Part A(Reverese Acceleration and Reverse Braking)/ Reverse Motoring and Reverse Braking, Draw four quadrants of Speed and Torque plane (3M)	18Min
3	• The problem of the motor is, the firing angle of the rectifier is 1800. Since the firing angle is 1800, the motor is rotating in reverse direction. • Firing angle= 70.34^0	Problem Identification(2M) Computation of speed, back emf(3M) Computation of Firing angle(2M)	18Min
4	Synchronous speed= 1500rpm Slip= 0.0867 New slip= 0.2 Load Torque=36.9N-m V=253.2V Line current=17.89A	Synchronous speed= 1500rpm(1M) Slip= 0.0867 (1M) New slip=0.2 Load Torque=36.9N-m(2M) V=253.2V(2M) Line current=17.89A(1M)	18Min
5	Rated armature current= 109.3 Rated power factor = 0.8lag Excitation voltage= 1603 L-54.90 V New armature current= 52.75, angle -54.90 Power factor 0.34 lagging	Rated armature current= 109.3(2M) Rated power factor = 0.8lag Excitation voltage= 1603 L-54.90 V(2M) New armature current= 52.75, angle -54.90 (3M) Power factor 0.34 lagging	18Min

Part C (4Q x 8M = 32 Marks)

Q No	Solution	Scheme of Marking	Max. Time required for each Question
6	J=7.457 kg-m^2 T=7.93N-m P=830.35W	Computing the value of equivalent Moment of Inertia (2M) Computing the value of equivalent Torque (4M) Computing the value of Power (2M)	19Min
7	Back Emf at rated speed = 226V Back Emf at 600rpm=141.25V Duty cycle=0.83	Back Emf at rated speed = 226V (2M) Back Emf at 600rpm=141.25V(3M) Duty cycle=0.83(3M)	20 Min
8	Related formula for max slip Modified expression for slip after adding the external resistance Computation of Resistance to be inserted per phase	Related formula for max slip (2M) Modified expression for slip after adding the external resistance (2M) Computation of Resistance to be inserted per phase (4M)	19Min
9 a)	E= 1515.489 Volts P max=1032.014 kW/phase T max =3285 N-m Total Torque for three phases= 9855 N-m	E= 1515.489 Volts P max=1032.014 kW/phase(2M) T max =3285 N-m Total Torque for three phases= 9855 N-m(2M)	10Min
9 b)	Classifications and explanation of drive	Classifications and explanation of drive(4M)	10Min