Syllabi of Courses offered by the Department of Electrical Engineering

[As per New Course Structure approved in the B. Tech. Ordinance (2019-20)]

for

B. Tech. II Year IV Semester (Electrical Engineering)

Department of Electrical Engineering

School of Engineering

Harcourt Butler Technical University

Kanpur-208002

B. Tech. 4th Semester Course Structure as per the B. Tech. Ordinance Academic Session 2019-20

Sr. No.	Course Type	Subject Code	Course Title	Credits (LTP)	Sessional Marks				ESE	Total
					MSE	TA	Lab.	Total		
1.	BSC	BMA-206	CONM	4 (3-1-0)	30	20	-	50	50	100
2.	PCC	EEE-202*	Electrical Machines-I	5 (3-1-2)	15	20	15	50	50	100
3.	PCC	EEE-204*	Electrical Circuit Analysis	3 (2-1-0)	30	20	-	50	50	100
4.	PCC	EEE-206*	Electrical Measurement and Measuring Instruments	4 (2-1-2)	15	20	15	50	50	100
5.	ESC	EEE-208*	Bio-medical Instrumentation	3 (2-1-0)	30	20	-	50	50	100
6.	HSMC	HHS-204	Organizational Behaviour	3 (3-0-0)	30	20	-	50	50	100
7.	MC (Non-credit)	ECS-202	Cyber Security	2 (2-0-0)	30	20	-	50	50	100
Total Credits				**22**						

Note: The Course Codes* are proposed by the Department. Course at Sr. No. 5 will be offered by EED.

EEE-202	Electrical Machines-I	3L: 1T: 2P	5 Credits	Course Type: PCC

Preamble:

This course will provide a good understanding to the students in the area of electrical machines. The course includes understanding of principles of electromagnetic conversion and D C machines. This course also gives an insight into single and three phase transformers.

Prerequisites: Engineering Mathematics, Basic Electrical Engineering

Course Outcomes:

On the successful completion of this course, students will be able to:

COs	Course Outcomes	Bloom's Level
CO1	Able to know about electrical machines	Remembering, Understanding
CO2	Able to understand and apply concepts of DC machines	Understanding, Applying
CO3	Able to understand and apply electromagnetic energy conversion principles	Understanding, Applying
CO4	Exhibit the knowledge of armature reaction, commutation, interpoles, windings, singly and double excited systems	Understanding, Analysing, Applying
CO5	Calculate emf, torque, current, losses etc.	Understanding, Analysing
CO6	Demonstrate fundamental understanding of transformers	Analysing, Evaluating

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	1	-	-	-	-	2
CO2	2	1	2	1	1	2	1	-	1	-	1	2
CO3	2	1	1	-	1	3	1	-	1	-	1	2
CO4	1	2	1	1	1	2	1	-	2	-	1	2
CO5	2	2	2	1	1	2	1	-	2	-	2	2
CO6	2	1	1	1	1	1	1	-	1	-	1	2
Avg.	2.0	1.3	1.2	0.7	0.8	2.0	1.0	0.0	1.2	0.0	1.0	2.0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) if there is no correlation, put "-"

Course Outcome 1:

1. Define and classify transformers.
2. Briefly discuss the energy storage in magnetic field.
3. Explain the principle of working of DC Machine.

Course Outcome 2:

1. Explain the phenomenon of voltage build in DC shunt generators.
2. Explain Ward Leonard method.
3. Write outcomes and limitations of Swinburn's Test.

Course Outcome 3:

1. What are singly excited systems?
2. Derive expression for emf generated in DC machines.
3. Make a comprehensive technical comparison of singly and double excited systems.

Course Outcome 4:

1. What is Armature Reaction?
2. What is Commutation?
3. Explain the purposes of Inter-poles and Compensating Windings.

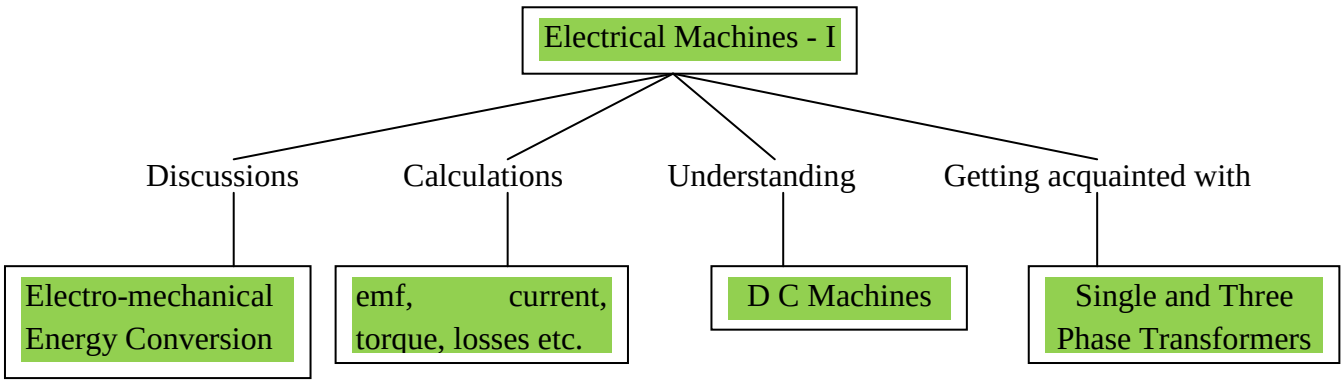
Course Outcome 5:

1. Derive expression for torque in machines with cylindrical air gap.
2. What do you understand by defining energy and co-energy?
3. Derive expressions for losses and efficiency of DC machines.

Course Outcome 6:

1. Explain efficiency and voltage regulation of transformer.
2. Describe parallel operation and load sharing of single phase and three phase transformers.
3. Explain Sumpner's Test and Polarity Test.

Concept Map



Module-I: Principles of Electro-mechanical Energy Conversion

Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque, Generated emf in machines; torque in machines with cylindrical air gap

[8L]

Module-II: D.C. Machines

Construction of DC Machines, Armature winding, emf and torque equation, Armature Reaction, Commutation, Inter-poles and Compensating Windings, Performance Characteristics of D.C. generators, Voltage build in DC shunt generators

[6L]

Module–III: D.C. Machines (Continued)

Performance Characteristics of D.C. motors, starting of D.C. motors; 3-point and 4-point starters, Speed control of D.C. Motors: Field Control, armature control and Voltage Control (Ward Leonard method); Losses, Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test)

[9L]

Module-IV: Single Phase Transformer

Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, Polarity test. Auto Transformer: Single phase and three phase auto transformers, volt-ampere relation, efficiency, Merits & demerits and applications

[8L]

Module-V: Three Phase Transformers

Construction, three phase transformer, Phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications, parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers

[9L]

List of Experiments:

(Note: At least eight experiments must be performed in a semester.)

1. To obtain magnetization characteristics of a D.C. shunt generator.
2. To obtain load characteristics of a D.C. shunt generator and compound generator (a) Cumulatively compounded (b) Differentially compounded.
3. To obtain efficiency of a DC shunt machine using Swinburn's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine.
5. To obtain speed-torque characteristics of a dc shunt motor.
6. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control.
7. To obtain speed control of dc separately excited motor using Conventional Ward-Leonard/ Static Ward –Leonard method.

8. To study polarity and ratio test of single phase and 3-phase transformers.
9. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using O.C. and S.C. tests.
10. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.
11. To obtain 3-phase to 2-phase conversion by Scott connection.
12. To determine excitation phenomenon (B.H. loop) of single phase transformer using C.R.O.

Text Books:

1. I. J. Nagrath & D. P. Kothari," Electrical Machines", Tata McGraw Hill
2. Ashfaq Husain, "Electrical Machines", Dhanpat Rai & Sons
3. A. E. Fitggerald, C. Kingsley Jr and Umans, "Electric Machinery", 6th Edition McGraw Hill, International Student Edition
4. B.R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines", New Age International

Reference Books:

1. Irving L. Kosow, "Electric Machine and Tranformers", Prentice Hall of India
2. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons
3. Bhag S. Guru and Huseyin R. Hizirogulu, "Electric Machinery and Transformers" Oxford University Press, 2001

Course Contents and Number of Lectures

Module No.	Topic (s)	No. of Lectures
1	Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems (defining energy & Co-energy), Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation,	4
1	Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque, Generated emf in machines; torque in machines with cylindrical air gap	4
2	Construction of DC Machines, Armature winding, emf and torque equation, Armature Reaction, Commutation, Inter-poles and Compensating Windings	3
2	Performance Characteristics of D.C. generators, Voltage build in DC shunt generators	3
3	Performance Characteristics of D.C. motors, starting of D.C. motors; 3-point and 4-point starters, Speed control of D.C. Motors: Field Control, armature control and Voltage Control	5
3	(Ward Leonard method); Losses, Efficiency and Testing of D.C. machines (Hopkinson's and Swinburn's Test)	4
4	Phasor diagram, efficiency and voltage regulation, all day efficiency. Testing of Transformers: O.C. and S.C. tests, Sumpner's test, polarity test.	4
4	Auto Transformer: Single phase and three phase auto transformers, volt-ampere relation, efficiency, merits & demerits and applications	4

5	Construction, three phase transformer, phasor groups and their connections, open delta connection, three phase to 2 phase, 6 phase or 12 phase connections, and their applications	5
5	Parallel operation and load sharing of single phase and three phase transformers, excitation phenomenon and harmonics in transformers, three winding transformers	4

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EEE-204	Electrical Circuit Analysis	2L: 1T: 0P	3 Credits	Course Type: PCC

Preamble:

This course will provide a good understanding about analysis to the students in the area of electrical circuits. The course includes understanding of graph theory, network analyses and Laplace Transform. This course also gives an insight into two port networks and network synthesis.

Prerequisites: Engineering Mathematics, Basic Electrical Engineering

Course Outcomes:

On the successful completion of this course, students will be able to:

COs	Course Outcomes	Bloom's Level
CO1	Able to know and analyse electrical circuits	Remembering, Understanding
CO2	Able to understand and apply concepts of graph theory and network theorems	Understanding, Applying
CO3	Able to understand and apply knowledge of series and parallel circuits, resonance, network synthesis	Understanding, Applying
CO4	Exhibit the knowledge of Laplace Transform, Dual Networks and Filters	Understanding, Analysing, Applying
CO5	Calculate circuit properties and do circuit analysis	Understanding, Analysing
CO6	Demonstrate fundamental understanding of circuit	Analysing, Evaluating

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	2	-	-	-	-	2
CO2	2	1	2	1	1	2	2	-	1	-	1	2
CO3	2	1	1	-	1	3	2	-	1	-	1	2
CO4	3	2	1	1	1	2	2	-	2	-	1	2
CO5	2	2	2	1	1	2	2	1	2	-	2	2
CO6	3	1	1	1	1	1	2	-	1	-	1	2
Avg.	2.5	1.3	1.2	0.7	0.8	2.0	2.0	0.2	1.2	0.0	1.0	2.0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) if there is no correlation, put "-"

Course Outcome 1:

1. Define Compensation Theorem.

2. What is duality? Discuss, Dual Networks.
3. Explain Transmission Parameters and Hybrid Parameters.

Course Outcome 2:

1. Define Tree, Co-tree and Link.
2. What are Incidence Matrix, Cut set Matrix and Tie set Matrix?
3. Explain Superposition Theorem with the help of an example.

Course Outcome 3:

1. Discuss series R-L, R-C and R-L-C circuits.
2. Discuss parallel R-L, R-C and R-L-C circuits.
3. Explain series and parallel resonances.

Course Outcome 4:

1. What is Laplace Transform?
2. What is Commutation?
3. Explain active and passive filters.

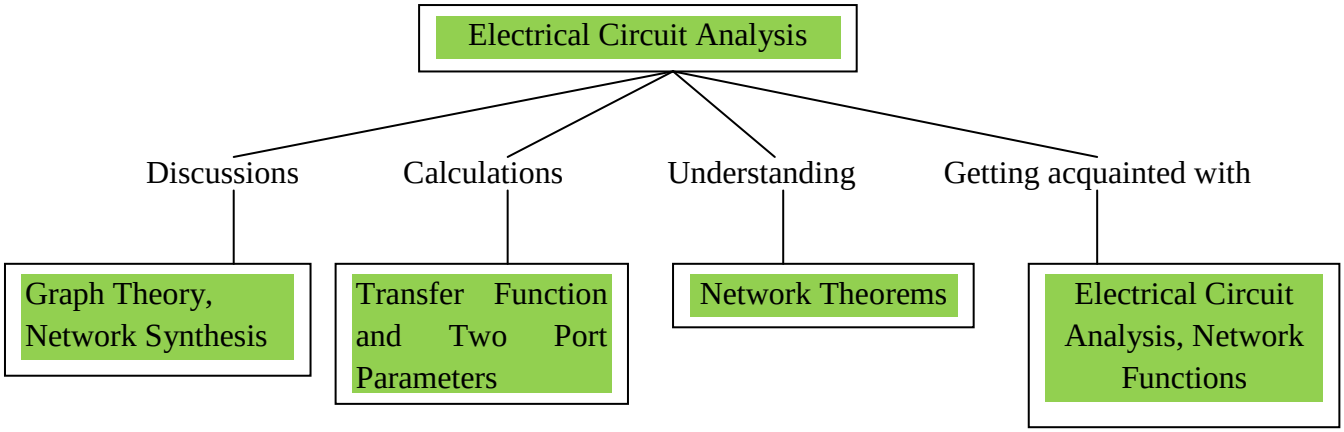
Course Outcome 5:

1. What are properties of L-C, R-C and R-L driving point functions?
2. Do synthesis of L-C, R-C and R-L driving point immittance functions using Foster and Cauer first and second forms.
3. What are forced and free responses?

Course Outcome 6:

1. Explain Mesh Analysis.
2. What are poles and zeros?
3. Define initial and final value theorems of Laplace Transform.

Concept Map



Syllabus

Module I: Graph theory

Graph of a Network, definitions: Tree, Co-tree, Link, Basic loop and Cut set, Incidence matrix, Cut set matrix, Tie set matrix, Loop and node equation based analysis, Concept of duality and dual networks

[6L]

Module II: Network Theorems

Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power transfer theorem, Reciprocity theorem, Compensation theorem, Analysis with dependent current and voltage sources, Node and Mesh Analysis

[8L]

Module III: Electrical Circuit Analysis using Laplace Transforms

Solution of first and second order Series and Parallel R-L, R-C, R-L-C circuits, Initial and final conditions in network elements, Forced and free response, Time constants, Steady-state and transient state response, Transfer function representation, Poles and Zeros, Frequency response (Magnitude and phase plots), Series and Parallel resonances

[10L]

Module IV: Two Port Network and Network Functions

Two port networks, Terminal pairs, relationship of two port variables, Impedance parameters, Admittance parameters, Transmission parameters and Hybrid parameters, Interconnections of two port networks

[6L]

Module V: Network Synthesis

Positive Real Function: Definition and properties, Properties of L-C, R-C and R-L driving point functions, Synthesis of L-C, R-C and R-L driving point immittance functions using Foster and Cauer first and second forms
Filter: Passive and active filter fundamentals, Low pass, High pass (Constant K-type) Filters, Introduction to Active filters

[10L]

Text Books:

1. M. E. Van Valkenberg, "Network Analysis, PHI, 2006.
2. D. Roy Choudhary, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E.Kemmerly", Engineering Circuit Analysis, McGraw Hill Edu., 2013.

Reference Books:

1. C. K. Alexander and M. N. O., Sadiku, Electric Circuits", McGraw Hill Education, 2004.
2. K. V. V. Murthy and M.S. Kanaih, "Basic Circuit Analysis", Jaico Publications, 1999.
3. Peikari – Fundamentals of Network Analysis & Synthesis, Wiley.
4. V. Atre, "Network Theory and Filter design", TMH

Course Contents and Number of Lectures

Module No.	Topic (s)	No. of Lectures
1	Graph of a Network, definitions: Tree, Co-tree, Link, Basic loop and Cut set, Incidence matrix, Cut set matrix	3
1	Tie set matrix, Loop and node equation based analysis, Concept of duality and dual networks	3
2	Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power transfer theorem, Reciprocity theorem	4
2	Compensation theorem, Analysis with dependent current and voltage sources, Node and Mesh Analysis	4
3	Solution of first and second order Series and Parallel R-L, R-C, R-L-C circuits, Initial and final conditions in network elements, Forced and free response, Time constants	5
3	Steady-state and transient state response, Transfer function representation, Poles and Zeros, Frequency response (Magnitude and phase plots), Series and Parallel resonances	5
4	Two port networks, Terminal pairs, relationship of two port variables, Impedance parameters, Admittance parameters	4
4	Transmission parameters and Hybrid parameters, Interconnections of two port networks	2
5	Positive Real Function: Definition and properties, Properties of L-C, R-C and R-L driving point functions, Synthesis of L-C, R-C and R-L driving point immittance functions using Foster and Cauer first and second forms	6
5	Filter: Passive and active filter fundamentals, Low pass, High pass (Constant K-type) Filters, Introduction to Active filters	4

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EEE-206	Electrical Measurement and Measuring Instruments	2L: 1T: 2P	4 Credits	Course Type: PCC

Preamble:

This course will provide a good understanding about analysis to the students in the area of electrical measurements and measuring instruments. The course includes understanding of principles of measurements, error analysis, analog instruments, digital measurements and CRO. This course also gives an insight into instrument transformers, potentiometers, various bridges and magnetic measurements.

Prerequisites: Engineering Mathematics, Basic Electrical Engineering

Course Outcomes:

On the successful completion of this course, students will be able to:

COs	Course Outcomes	Bloom's Level
CO1	Able to know and analyse principles of measurements	Remembering, Understanding
CO2	Able to understand and apply concepts of analog instruments and digital measurements	Understanding, Applying
CO3	Able to understand and apply knowledge of CRO	Understanding, Applying
CO4	Exhibit the knowledge of magnetic measurement and instrument transformers	Understanding, Analysing, Applying
CO5	Calculate measurement errors and do error analysis	Understanding, Analysing
CO6	Demonstrate fundamental understanding of measurement bridges	Analysing, Evaluating

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	2	-	-	-	-	2
CO2	2	1	2	1	1	2	2	-	1	-	1	3
CO3	2	1	1	-	1	3	2	-	1	-	1	2
CO4	3	1	1	1	1	2	2	-	2	-	1	3
CO5	2	1	2	1	1	3	2	1	2	-	2	2
CO6	3	1	1	1	1	3	2	-	1	-	1	3
Avg.	2.5	1.0	1.2	0.7	0.8	2.5	2.0	0.2	1.2	0.0	1.0	2.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) if there is no correlation, put "-"

Course Outcome 1:

1. What is philosophy of engineering measurements?
2. What is difference between measurement and instrumentation?
3. Explain working of CRO.

Course Outcome 2:

1. Differentiate between analog and digital measurements.
2. How PMMC instruments work?
3. Explain working principle of Moving Iron instruments.

Course Outcome 3:

1. List applications of CRO.
2. Discuss applications of CRO in measurements of Phase and Frequency.
3. What are Dual-Trace and Dual-Beam Oscilloscopes?

Course Outcome 4:

1. What are principles of operation of Current Transformer and Potential Transformer?
2. Explain Ballistic Galvanometer.
3. What is Flux meter? List its advantages and applications.

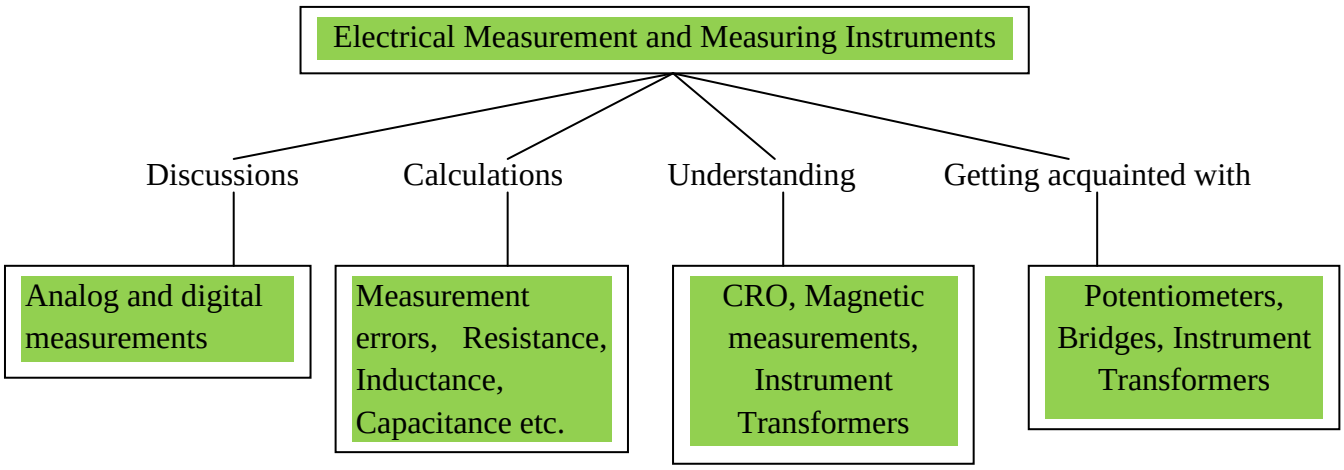
Course Outcome 5:

1. What are various errors in measurement?
2. How measurement error is carried out? List and explain its methods.
3. What is calibration?

Course Outcome 6:

1. Differentiate D.C. and A.C. Bridges.
2. How Inductance, Capacitance and Quality factor are measured?
3. Explain methods of measurements of Low, Medium, and High Resistances.

Concept Map



Syllabus

Module-I: Principles of Measurement and Error Analysis

Methods of measurement, Measurement system, Classification of instrument system, Characteristics of instruments and measurement systems, Errors in measurement and its analysis

[5L]

Module-II: Analog Instruments

Classification, Principle of operation of Permanent Magnet Moving Coil and Moving Iron Instruments, Voltmeters and Ammeters, Errors in Voltmeters and Ammeters, Electrodynamometer type Instruments, Power measurement.

[6L]

Module-III: Digital Measurements and Cathode Ray Oscilloscopes (CROs)

Digital Measurement of Electrical Quantities, Block Diagram study of Digital Voltmeter, Frequency Meter, Basic CRO Circuit (Block Diagram), Cathode Ray Tube (CRT) and its Components, Applications of CRO in measurements of Phase and Frequency, Dual-Trace and Dual-Beam Oscilloscopes

[6L]

Module-IV: Potentiometers and Bridges

D.C. and A.C. Potentiometers, D.C. and A.C. Bridges, Measurement of Inductance, Capacitance and Quality factor, Measurement of Low, Medium, and High Resistances

[5L]

Module V: Instrument Transformers and Magnetic Measurements

Principle of operation of Current Transformer and Potential Transformer, Error Analyses, Magnetic measurements, Ballistic Galvanometer, Flux meter, Advantages and Applications

[5L]

Proposed List of Experiments

(Note: At least eight experiments must be performed in a semester.)

1. Measurement of Inductance by Maxwell Inductance Capacitance Bridge.
2. Measurement of Inductance by Anderson Bridge.
3. Measurement of Capacitance by Schering Bridge.
4. Measurement of Capacitance by Wien's Bridge.
5. Calibration of AC Voltmeters and Ammeters.
6. Measurement of Resistance with the help of Ammeter-Voltmeter method.
7. Measurement of Low Resistance by Kelvin's Double Bridge.
8. Measurement of High Resistance and Insulation Resistance using Megger.
9. Measurements of Phase and Frequency using CRO.
10. Study of the Digital Storage Oscilloscope (DSO) and Measurements of Phase and Frequency.

Text Books:

1. A. K. Sawhney, "Electrical and Electronic Measurements & Instrumentation", Dhanpat Rai & Sons.
2. E. W. Golding & F. C. Widdis, "Electrical measurement & measuring instruments" A. H. Wheeler & Co.Pvt Ltd. India.
3. A. D. Helfrick & W. D. Cooper, "Electronic Instruments & Measurement Technique" Prentice Hall of India.

Reference Books:

1. David A. Bell, "Electronic Instrumentation & Measurement" Prentice Hall of India.
2. M. B. Stout, "Basic Electrical measurement" Prentice Hall of India.
3. H. S. Kalsi, "Electronic Instrumentation" Tata Mc-Graw Hill.

Course Contents and Number of Lectures

Module No.	Topic (s)	No. of Lectures
1	Methods of measurement, Measurement system, Classification of instrument system	3
1	Characteristics of instruments and measurement systems, Errors in measurement and its analysis	2
2	Classification, Principle of operation of Permanent Magnet Moving Coil and Moving Iron Instruments, Voltmeters and Ammeters	3
2	Errors in Voltmeters and Ammeters, Electrodynamometer type Instruments, Power measurement	3
3	Digital Measurement of Electrical Quantities, Block Diagram study of	3

	Digital Voltmeter, Frequency Meter, Basic CRO Circuit (Block Diagram)	
3	Cathode Ray Tube (CRT) and its Components, Applications of CRO in measurements of Phase and Frequency, Dual-Trace and Dual-Beam Oscilloscopes	3
4	D.C. and A.C. Potentiometers, D.C. and A.C. Bridges, Measurement of Inductance, Capacitance and Quality factor	3
4	Measurement of Low, Medium, and High Resistances	2
5	Principle of operation of Current Transformer and Potential Transformer, Error Analyses, Magnetic measurements	3
5	Ballistic Galvanometer, Flux meter, Advantages and Applications	2

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EEE-208	Biomedical Instrumentation	2L: 1T: 0P	3 Credits	Course Type: PCC

Preamble:

This course will provide a good understanding about analysis to the students in the area of biomedical instrumentation. The course includes understanding of bio-potentials, electrodes, half-cell potential and polarisation effects. This course also gives an insight into biomedical equipment and imaging systems.

Prerequisites: Engineering Mathematics, Engineering Physics

Course Outcomes:

On the successful completion of this course, students will be able to:

COs	Course Outcomes	Bloom's Level
CO1	Able to know and analyse principles of biomedical measurements	Remembering, Understanding
CO2	Able to understand and apply concepts of bio-potentials and bio-electrodes	Understanding, Applying
CO3	Able to understand and apply knowledge of half-cell potential and polarisation	Understanding, Applying
CO4	Exhibit the knowledge of biomedical equipment	Understanding, Analysing, Applying
CO5	Calculate half-cell potential, bio-potentials and outputs of equipment	Understanding, Analysing
CO6	Demonstrate fundamental understanding of biomedical imaging	Analysing, Evaluating

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	2	-	-	-	-	2
CO2	2	2	2	1	1	2	2	-	1	-	1	3
CO3	2	1	1	-	1	3	2	-	1	-	1	2
CO4	3	2	1	1	2	2	2	-	2	-	1	3
CO5	2	1	2	1	1	3	2	1	2	-	2	2
CO6	3	2	1	1	1	3	2	-	1	-	1	3
Avg.	2.5	1.5	1.2	0.7	1.0	2.5	2.0	0.2	1.2	0.0	1.0	2.5

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) if there is no correlation, put "-"

Course Outcome 1:

1. What is philosophy of biomedical measurements?
2. List various biomedical equipment.
3. Explain ECG–Einthoven's triangle.

Course Outcome 2:

1. Discuss characteristics of various bio-potentials.
2. Explain EEG–10-20 electrode system.
3. Compare EMG, EOG and ERG electrodes.

Course Outcome 3:

1. What is half-cell potential?
2. Discuss polarization effects of electrodes.
3. What are non-polarizable electrodes?

Course Outcome 4:

1. List various biomedical diagnostic and therapeutic equipment?
2. Explain Electro-cardioscope.
3. What is principle of operation of dialysis machine?

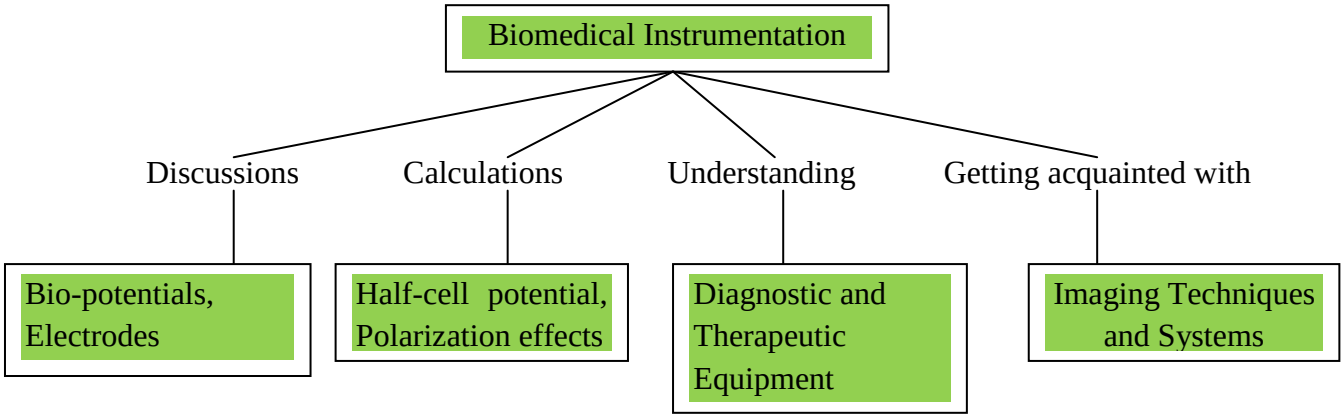
Course Outcome 5:

1. What are various errors in biomedical measurements?
2. List and explain various bio-potentials.
3. How medical instrument are calibrated?

Course Outcome 6:

1. Differentiate SPECT Scanner and PET scanner.
2. What is principle of operation of NMR Imaging systems?
3. Explain various Electrical Safety codes and standards in the area of biomedical instrumentation.

Concept Map



Syllabus

Module I:

Bio-potentials–characteristics, ECG–Einthoven's triangle–3 lead ECG system, EEG–10-20 electrode system, Origin and characteristics of EMG, EOG and ERG electrodes and transducers

[6L]

Module II:

Electrode-electrolyte interface, Half-cell potential, Polarization effects of electrode, Non-polarizable electrodes, Types of electrodes surface, needle and micro electrodes, ECG, EMG and EEG Electrodes

[5L]

Module III:

Diagnostic and Therapeutic Equipment: Blood pressure monitors – Electrocardioscope - Pulse Oximeter - pH meter - Auto analyser – Pacemakers – Defibrillator - Dialysis machine

[5L]

Module IV:

Medical imaging techniques: Basics of diagnostic radiology, Production nature and properties of X-rays, X-ray machine, Digital radiography, CT basic principle, SPECT Scanner, PET scanner

[6L]

Module V:

Principles of NMR Imaging systems, Ultrasonic Imaging Systems, Doppler Effect, Medical Ultrasound, Electrical Safety codes and standards, Protection of patients

[5L]

Text Books:

1. R S Khandpur, "Handbook of Biomedical Instrumentation", 1st ed., Tata McGraw Hill Publishing Company Limited, 2004.

2. John G Webster, "Medical Instrumentation - Application and Design", 4th ed., John Wiley and Sons, 2007.

Reference Books:

1. Principles of Biomedical Instrumentation and Measurement, Richard Aston Merrill, Publishing Company, 1990.
2. Bio medical Instrumentation and Measurements, Cromwell Leslie, Fred J. Weibell, Erich A. Pfeiffer, PHI, 2nd edition, 2004.

Course Contents and Number of Lectures

Module No.	Topic (s)	No. of Lectures
1	Bio-potentials–characteristics, ECG–Einthoven's triangle–3 lead ECG system, EEG–10-20 electrode system	3
1	Origin and characteristics of EMG, EOG and ERG electrodes and transducers	3
2	Electrode-electrolyte interface, Half-cell potential, Polarization effects of electrode, Non-polarizable electrodes	3
2	Types of electrodes surface, needle and micro electrodes, ECG, EMG and EEG Electrodes	2
3	Diagnostic and Therapeutic Equipment: Blood pressure monitors – Electrocardioscope - Pulse Oximeter	3
3	pH meter - Auto analyser – Pacemakers – Defibrillator - Dialysis machine	2
4	Medical imaging techniques: Basics of diagnostic radiology, Production nature and properties of X-rays	3
4	X-ray machine, Digital radiography, CT basic principle, SPECT Scanner, PET scanner	3
5	Principles of NMR Imaging systems, Ultrasonic Imaging Systems, Doppler Effect, Medical Ultrasound	3
5	Electrical Safety codes and standards, Protection of patients	2

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