MCKV INSTITUTE OF ENGINEERING

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Curriculum for Undergraduate Degree (B.Tech.) in Electrical Engineering (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Fourth Semester (Second Year)

Course Name:	**Electric Machine-I**		
Course Code:	PC-EE401	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	04
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical and Electronics Engineering (ES-EE-201), Electric Circuit Theory (PC-EE-301), Electromagnetic Field Theory (PC-EE-303)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To review the concept of magnetic fields and magnetic circuits
2	To learn the principle of production of electromagnetic force and torque.
3	To learn the basic principle of operation of DC machine
4	To learn the principle of operation and characteristics of DC motor and generator
5	To learn the principle of operation, connections and different tests on Transformers
6	To acquire problem solving skills to solve problems of DC machines and Transformers

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Electromechanical Energy Conversion Principle:** Singly Excited Magnetic System and Doubly Excited Magnetic system. Physical concept of torque production; Electromagnetic torque and Reluctance torque. **Concept of General terms pertaining to Rotating Machines:** Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air, MMF produced by Distributed Windings, Electrical & Mechanical degree.	8L

2	**DC Machines:** **Basic construction of a DC machine:** Field and armature, Types of armature winding: lap and wave windings, EMF generated in the armature, Derivation of EMF equation, Methods of Excitation, Armature reaction & its effect in the performance, Methods of decreasing the effects of Armature reaction, Effect of Brush shift. Compensating winding, Commutation process, Construction of commutator, Resistance commutation, Delayed commutation, Voltage commutation, Improvement of Commutation, Brush shift and interpoles. **Operating Characteristics of DC Generators:** Separately Excited generators, Shunt Generators, Series Generators and Compound Generators. **Direct Current motors:** Review of types of DC motors, Torque equation, Derivation of back EMF equation. **Speed torque characteristics:** shunt, series and compound motors. **Starting of DC motors:** 3-point starter & its step calculation, 4-point starter, Speed control by controlling armature resistance, field excitation and armature voltage. Ward- Leonard method of speed control. Losses & efficiency of DC machines, Hopkinson's & Swinburne's test. **D.C Machine application**: Generator application, Motor application	14L
3	**1-phase Transformers:** Construction and operation of single-phase transformers, Equivalent circuit, Phasor diagram, Voltage regulation, Losses and efficiency Testing - open circuit and short circuit tests, Polarity test, Back-to-back test, Parallel operation of single-phase transformers, Separation of hysteresis and eddy current losses.	6L
4	**3-phase Transformers:** Three-phase transformer - construction, Determination of polarity and connections (star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), Phasor groups and their comparative features. Magnetizing current, Effect of unbalanced loading, Production of Harmonics in Transformer and its suppression, Autotransformers - construction, principle, applications and comparison with two winding transformer, Phase conversion - 3 phase to 2 phase transformation, Scott connection, three-phase to six-phase conversion, Double star and Double delta, 3 winding transformer: Parameter estimation, application, Parallel operation of three-phase transformers, Tap-changing transformers - No-load and on-load tap-changing of transformers, Cooling of transformers. **Special Transformers:** Potential transformer, Current transformer, Pulse transformer, Audio frequency transformer, Grounding transformer, Pulse transformer.	12L
Total		**40L**

Course Outcomes:
After completion of the course, students will be able to:

1	Discuss general concept pertaining rotating machines and magnetic fields, EMFs and torque production
2	Explain the construction, operation, different types of DC machine and analysis of characteristics curve.
3	Describe construction, operation of single phase transformer.
4	Describe construction, operation of three phase transformer and different types of three phase transformer with their operation.
5	Solve different electrical circuits sing DC machine, single and three phase Transformer depending on the desired output.

Learning Resources:	
Recommended Text Books	
1	Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers.
2	Theory and Performance of Electric Machines, J. B. Gupta, Katson Books.
3	Electric Machines: Theory, Operating Applications, and Controls, Charles I. Hubert, 2/e, Pearson Education.
Alternative Text Books	
4	The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5	Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India
6	Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
Reference Books	
7	Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.
8	Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
9	Electrical Machines, R.K. Srivastava, Cengage Learning
10	Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition

Course Name:	**Digital Electronics**		
Course Code:	PC-EE402	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	03
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics (PC-EE-302)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the fundamentals of Digital systems and principle of operation of Logic families
2	To learn the principle of operation of Combinational digital circuits
3	To learn the principle of operation of sequential circuit and systems.
4	To learn the principle of operation of A/D and D/A converter

5	To learn the principle of operation of semiconductor memories and Programmable logic devices
6	To acquire problem solving skills to solve problems of Digital circuits

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Fundamentals of Digital systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, 1's and 2's complements arithmetic, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	7L
2	**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of Logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, digital comparator, parity checker/generator, codes and code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	7L
3	**Sequential circuit and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC"s, asynchronous sequential counters, applications of counters.	7L
4	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/ converter, R-2R Ladder, D/A converter, specifications for D/A converters, examples of D/A converter, ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.	7L
5	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	7L

Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand different Number systems, Codes, Logic Gates, Boolean laws & theorems to simplify the Boolean functions to the minimum number of literals and the digital logic families..
2	Design different types of combinational and sequential logic circuits using Logic gates and Flip Flops respectively.
3	Understand the operation of different types ADC, DAC and memory system.

Learning Resources:	
Recommended Text Books	
1	Modern Digital Electronics, 4th Edition, R.P. Jain. Tata Mc Graw Hill Company Limited
2	Digital Logic Design, Morries Mano, PHI
3	Fundamental of Digital Circuits, A. Anand Kumar, 4th Edition, PHI.
Alternative Text Books	
5	Digital Electronics, R. Anand, Khanna Publishing House (2018).
6	Digital Integrated Electronics, H. Taub & D. Shilling, Mc Graw Hill Company.
7	Digital Electronics, Principles, Devices and Applications, Anil K. Maini,Jhon Wiley & Sons, Ltd, 2007.
Reference Books	
7	Digital Electronics, James W. Bignell & Robert Donovan, Thomson Delman Learning.
8	Digital Principles & Application, 5th Edition, Leach & Malvino, Mc Graw Hill Company
9	Fundamental of logic Design, Charles H. Roth, Thomson Delman Learning.

Course Name:	**Electrical and Electronics Measurement**		
Course Code:	PC-EE403	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	03
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical and Electronics Engineering (ES-EE-201), Electric Circuit Theory (PC-EE-301)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn methods of measurement, errors in measurement and its classification.
2	To learn the principle of operation of analog and digital meters

3	To learn the basic principle of operation of instrument transformers.
4	To learn the principle of operation of cathode ray oscilloscope and different sensors and transducers.
5	To learn the principle of measurement of power, energy and different electrical parameters
6	To acquire problem solving skills to solve problems on the topics studied.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Measurements: • Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments. Analog meters: • General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamometer, Induction instruments, Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers.	7L
2	Instrument transformer: • Disadvantage of shunt and multipliers for AC Measurement, Advantage of Instrument transformers, Principle of operation of current & potential transformer, errors. Measurement of Power: • Principle of operation of Electrodynamic & Induction type wattmeter, Wattmeter errors. Measurement of Energy: • Construction, theory and application of AC energy meter, testing of energy meters.	9L
3	Measurement of resistance and impedances: • Measurement of medium, low and high resistances, Megger Potentiometer: • Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer, applications AC Bridges: • Measurement of Inductance, Capacitance and frequency by AC bridges.	8L
4	Cathode ray oscilloscope (CRO): • Principle of oscilloscope, Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. Electronic Instruments:	7L

	• Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator, Digital Storage oscilloscope	
5	Sensors & Transducers: • Introduction to sensors & Transducers, Strain gauge, LVDT, Temperature transducers, Flow measurement using magnetic flow measurement.	4L
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic measurement systems, analog meters, instrument transformers, energy meters, bridge, potentiometers, CROs, DSOs, sensors and transducers.
2	Apply the concept of measurement system for concluding about the pros and cons of the system
3	Evaluate the parameters associated with the instruments.
4	Use the measurement system for recording and controlling system variables.
5	Use the measurement system for data manipulation and analysis.

Learning Resources:	
Recommended Text Books:	
1	A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2	A Course in Electronics and Electrical Measurements and Instrumentation, J.B. Gupta, S K Kataria and Sons Publisher
Alternative Text Books	
3	Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing
4	Industrial Instrumentation and control, S K Singh, Tata McGraw-Hill.
Reference Books	
5	Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
6	Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition
7	Modern Electronic instrumentation & Measuring instruments, A.D. Helfrick & W.C. Copper, Wheeler Publication.
8	Sensors & Transducers, D. Patranabis, PHI, 2nd edition
9	Instrument transducers, H.K.P. Neubert, Oxford University press.
10	All-in One Electronics Simplified, A.K. Maini, Khanna Book Publishing Co. (2018)

Course Name:	**Engineering Mechanics**		
Course Code:	ES-ME401	**Category:**	Engineering Science Courses
Semester:	4th	**Credit:**	03
L-T-P:	3-0-0	**Pre-Requisites:**	Physics (BS-PH-201), Mathematics (BS-M101,

			BS-M201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the basic mathematical tools to deal with the physical bodies.
2	To learn different mathematical techniques to analyze physical bodies.
3	To learn analysis techniques of rigid bodies.
4	To solve problem of general motion.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Free, Forced and fixed vectors. · Force System: Force, Classification & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces, Moment of a force, Vector representation, Moment for coplanar force system, Varignon's theorem.	4L
2	Couple, Vector representation, Resolution of a force into a force and a couple. · Force Systems: Coplanar Concurrent Force system and Coplanar Non Concurrent force systems, Resultant of coplanar force system. · Equilibrium of coplanar force system, Free body diagrams.	3L
3	**Kinematics of Rigid Body**: Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.	6L
4	**Kinetics of Rigid Bodies** Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.	5L
5	**General Motion** Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.	9L
6	**Bending Moment** Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams..	5L

7	**Torsional Motion** Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.	2L
8	**Friction** Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of frictio	3L
9	**Vibrations**– Free and forced vibration of undamped and damped single DOF systems, Effect of damping, Vibration Isolation, Critical Speed of Shafts.	3L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the co-ordinate system, principle of three dimensional rotation, kinematics and kinetics of rigid bodies.
2	Elaborate the theory of general motion, bending moment, torsional motion and friction
3	Develop free body diagram of different arrangements.
4	Solve problems with the application of theories and principle of motion , friction and rigid bodies.
5	Analyze torsional motion and bending moment.

Learning Resources:	
1	J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2	M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.
3	Manoj K. Harbola, "Engineering Mechanics", Cengage Learning India Pvt. Ltd, 2018.
4	D.S. Bedi & M.P. Poonia, "Engineering Mechanics", Khanna Publishing House, 2019.
5	R.S. Khurmi, "Engineering Mechanics", S.Chand Publications
6	R.K. Bansal, "Engineering Mechanics", Laxmi Publications

Course Name:	**Values and Ethics in Profession**		
Course Code:	HM-HU402	**Category:**	Management Science and Humanities
Semester:	4th	**Credit:**	02
L-T-P:	2-0-0	**Pre-Requisites:**	Not applicable
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.

2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Concept of Human Values, Ethics and Profession; Engineering as a profession	2L
2.	Societal values: justice, democracy, secularism, rule of law; Maslow's Hierarchy and Integrated personality; Value Crisis in contemporary society.	5L
3.	Codes of professional ethics. Whistle blowing and beyond. Case studies.	3L
4	Human Operator in Engineering projects and industries. Problems of man machine interaction.	2L
5	Rapid Technological growth and depletion of resources. Reports of the Club of Rome. Limits of growth; sustainable development.	4L
6	Environmental degradation and pollution. Eco-friendly Technologies; Appropriate Technology Movement of Schumacher: later developments.	3L
7	Emotional Intelligence – Salovey – Mayer Model ;Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan"s Argument – Heinz's Dilemma -Intellectual Property Rights.	5L
Total		**24L**

Course Outcomes:

After completion of the course, students will be able to:

1	The students are able to see that verification on the basis of natural acceptance and experiential validation through living is the only way to verify right or wrong, and referring to any external source like text or instrument or any other person cannot enable them to verify with authenticity; it will only develop assumptions.
2	The students are able to grasp the right utilization of their knowledge in their streams of Technology/Engineering/ Management to ensure mutually enriching and recyclable productions systems
	The students are able to see that lack of right understanding leading to lack of relationship is the major cause of problems in their family and not the lack of

3	physical facilities in most of the cases, while they have given higher priority to earning of physical facilities in their life ignoring relationships and not being aware that right understanding is the most important requirement for any human being

Learning Resources:	
1	Stephen H Unger, Controlling Technology: Ethics and the Responsible Engineers, John Wiley & Sons, New York 1994 (2nd Ed)
2	Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991
3	A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta ,1996
4	Samita Manna and Suparna Chakraborti:Values and Ethics in Profession
5.	S.K.Sarangi,Values and Ethics in Profession

Laboratory

Course Name:	**Electric Machine-I Lab**		
Course Code:	PC-EE491	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To learn operating principle and characteristics of DC motor and generator
2	To learn the operating principle and characteristics of single and thee phase transformer
3	To calculate parameters and study different connections of three phase transformer
4	To understand performance of the transformer using different operations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Determination of the characteristics of a separately excited DC generator.	3P
2	Determination of the characteristics of a DC motor	3P
3	Study of methods of speed control of DC motor	3P
4	Determination of the characteristics of a compound DC generator (short shunt)	3P
5	Determination of speed of DC series motor as a function of load torque.	3P
6	Polarity test on a single phase transformer	3P
7	Determination of equivalent circuit of a single phase transformer and efficiency.	3P
8	Study of different connections of three phase transformer.	3P

9	Study of Parallel operation of a single phase transformers.	3P
10	Determination of temperature rise and efficiency of the transformer.(Back to back test)	3P
Total		**30P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Determine no load characteristics of separately excited generator and compound DC generator (short shunt).
2	Demonstrate load characteristics, speed control of a DC shunt motor and load characteristics of a DC series motor.
3	Demonstrate open-circuit and short-circuit tests of single phase transformer to determine the parameters, efficiency and polarity test, group connection of three phase transformer.
4	Demonstrate parallel operation, back to back test of the transformer
5	Determine parameters of three phase induction motor performing no load and blocked rotor test.
6	Study the performance of wound rotor induction motor under load.

Course Name:	**Digital Electronics Lab**		
Course Code:	PC-EE492	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To learn and understand the Basics of digital electronics
2	To design basic logic circuits
3	To design combinational logic circuit
4	To design sequential logic circuit

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Realization of basic gates using Universal logic gates.	2P
2	4-bit parity generator & comparator circuits	2P
3	Construction of simple Decoder & Multiplexer circuits using logic gates.	2P
4	Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer	2P
5	Construction of simple arithmetic circuits-Adder, Subtractor	2P
6	Realization of RS-JK & D flip-flops using Universal logic gates.	2P
7	Realization of Universal Register using JK flip-flops & logic gates.	2P

8	Realization of Universal Register using multiplexer & flip-flops.	2P
9	Construction of Adder circuit using Shift Register & full Adder	2P
10	Realization of Asynchronous Up/Down counter	2P
11	Realization of Synchronous Up/Down counter	2P
12	BCD Adder	2P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Validate the operation of code conversion circuit –BCD to Excess 3 & vice versa, 4 bit parity generator & comparator circuits.
2	Construct decoder , multiplexer, adder and subtractor circuits with appropriate instruments and precaution.
3	Realize RS-JK and D flip flop, universal register with gates, multiplexer and flip-flops and asynchronous and synchronous up down counters.
4	Realize A/D and D/A converters circuits

Course Name:	**Electrical and Electronics Measurement Lab**		
Course Code:	PC-EE493	**Category:**	Professional Core Courses
Semester:	4th	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Knowledge of Basic Electrical Engineering and Electric Circuit Theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To learn methods of measurement, errors in measurement and its classification.
2	To learn the principle of operation of analog and digital meters.
3	To learn the basic principle of operation of instrument transformers.
4	To learn the principle of measurement of power, energy and different electrical parameters

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Instrument workshop- Observe the construction of PMMC, Dynamometer, Electrothermal and Rectifier type of instruments, Oscilloscope and Digital multi-meter.	3P
2	Calibrate AC energy meter.	3P
3	Measurement of resistance using Kelvin double bridge.	3P
4	Measurement of power using Instrument transformer.	3P
5	Measurement of power in Polyphase circuits.	3P

6	Measurement of frequency by Wien Bridge.	3P
7	Measurement of Inductance by Anderson bridge.	3P
8	Measurement of capacitance by De Sauty Bridge.	3P
9	Measurement of capacitance by Schering Bridge.	3P
10	Measurement of Coil self-Inductance by Hay's bridge.	3P
Total		**30P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Observe the construction of basic measurement system instruments.
2	Calibration of AC energy single phase energy meter using dynamometer type wattmeter.
3	Measure resistance using Kelvin Double Bridge.
4	Analyze power in electrical systems using instrument transformer and poly-phase circuits.
5	Prepare at setup for frequency measurement using Wien's Bridge.
6	Measure inductance using Anderson Bridge & Hay's bridge
7	Measure capacitance using De- Sauty and Schering Bridge.

Course Name:	**Environmental Science**		
Course Code:	MC471	**Category:**	Basic Science Courses
Semester:	4th	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concepts of Environmental Science
Full Marks:	100		
Examination Scheme:	Semester Examination: 100		

Course Objectives:	
1	Purpose: We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects this ethos. There is a direct application of this wisdom even in modern times.
2	Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	(a) **Awareness Activities:** i) Small group meetings about any of the topic. ii) Slogan making event iii) Poster making event iv) Seminar on any of the topic. v) Preparation of a report on any of the topic regarding current scenario.	 4L 2L 5L 4L 4L
	(b) Actual Activities: i) Plantation ii) Gifting a tree to see its full growth iii) Cleanliness drive iv) Drive for segregation of waste v) Shutting down the fans and ACs of the campus for an hour or so	 1L 1L 1L 1L 1L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic concepts, man, society & environment, their interrelationship, mathematics of population growth and associated problems, steady state conservation system.
2	Demonstrate natural environmental hazards like flood, earthquake, landslide-causes, effects and control/management.
3	Classify air pollution, water pollution, land pollution, noise pollution and their controls.
4	Study Elements of ecology and environmental management.

Learning Resources:	
1	M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House, New Delhi, 2019
2	Environmental science by Gillbert G. Master