Revised Syllabus (Effective from the session 2025-26)

GurukulaKangri (Deemed to be University), Haridwar
Faculty of Engineering & Technology
B. Tech. Electrical Engineering

Third Year **Semester-V**

S. No	COURSE CODE	COURSE TITALE	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EVALUATION			ESE	
THEORY										
			L	**T**	**P**	**CREDIT**	**CT**	**TA**	**TOTAL**		
1	BEE-C 511	Power System-I	3	0	0	3	20	10	30	70	100
2	BEE-C 512	Control System	3	0	0	3	20	10	30	70	100
3	BEE-C 513	Electric Drives & Their Control	3	0	0	3	20	10	30	70	100
4	BEE-M 001	Universal Human Values	3	0	0	3	20	10	30	70	100
5	BEE-O XXX	Open Elective-I	3	0	0	3	20	10	30	70	100
6	BXX-PXXX	Program Elective-I	3	0	0	3	20	10	30	70	100
PRACTICAL											
7	BEE-C 561	Power System-I Laboratory	0	0	2	1	10	05	15	35	50
8	BEE-C 562	Control System Laboratory	0	0	2	1	10	05	15	35	50
9	BEE-C 563	Electric Drives Laboratory	0	0	2	1	10	05	15	35	50
10	BEE-S 569	Summer Training and Internship Program-I/ Mini Project (3-4 Weeks)				1	To be pursued during summer vacation, submit a certificate of completion in the department (in summer break after IV semester exam and will be assessed during V semester)				50
TOTAL			**18**	**0**	**6**	**22**	**150**	**75**	**225**	**525**	**800**

Program Elective-I

1. BCE-P 515 Object Oriented Programming Using C++
2. BEE-P 516 Energy Audit

Open Elective-I

1.BEE-O 517 Industrial Electrical Systems
2.BEE-O 518 Sensor and Transducers

L	**Lecture**	**T**	Tutorial	**C**	Discipline Specific Course
CT	Cumulative Test	**TA**	Teacher Assessment	**ESE**	End Semester Examination
BEE	Electrical Code	**BET**	Electronics Code	**O**	Open Elective

Course Code: BEE-C511
Course Name: Power System-I

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic Electrical Engineering, Electrical Machines-I, Electrical Machines-II
Objectives:	1. Familiarize the students with the basic concept and structure of power system. 2. Study the different Sources of energy and supply system 3. Understand the overhead and underground transmission system 4. Understand the corona interference and mechanical consideration 5. Study the neutral grounding, EHV AC and HVDC transmission
Course Coordinator	Dr. Ashish Dhamanda

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight(08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
UNIT-1	Module-I Basic Concepts	Evolution of Power Systems and Present-Day Scenario, Structure of a power system: Bulk Power Grids and Micro-grids. Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator.	04	PO1/ PO2/ PO3/ PO4 PO6/ PO8/ PO9/ PO10/PO12	PSO1/PSO3
	Module-II Power Generation	Sources of electric energy: conventional and nonconventional Sources; Renewable and Non-Renewable Energy Sources. Energy Storage.	03	PO1/ PO2/ PO6/ PO8/ PO10/PO12	PSO1/PSO3
UNIT-2	Module-III Supply System	Different kinds of supply system and their comparison, choice of transmission voltage.	02	PO1/ PO2/ PO3/ PO4 PO6/ PO8/ PO9/ PO10/PO12	PSO1/PSO2/PSO3
	Module-IV Transmission Lines	Configurations, types of conductors, skin effect, Kelvin's Law, Proximity Effect.	03	PO1/ PO2/ PO3/ PO4 PO6/PO9/ PO10/PO12	PSO1/PSO2/PSO3
	Module-V Overhead Transmission Lines	Calculation of inductance and capacitance of single phase, three phase transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading, ABCD, h, Image Parameters.	04	PO1/ PO2/ PO3/ PO4/PO5 PO6/ PO7/ PO9/ PO10/PO12	PSO1/PSO2/PSO3

UNIT-3	Module-VI Corona and Interference	Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electro static and electromagnetic interference with communication lines.	04	PO1/ PO2/ PO3/ PO4/PO5 PO6/ PO7/ PO9/ PO10/PO12	PSO1/PSO2/PSO3
	Module-VII Overhead line Insulators	Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency.	04	PO1/ PO2/ PO3/ PO4/PO5 PO6/ PO7/ PO9/ PO10/PO12	PSO1/PSO2/PSO3
UNIT-4	Module-VIII Mechanical Design of transmission line	Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers. Insulated cables: Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, di electric loss, heating of cables.	08	PO1/ PO2/ PO3/ PO4/PO5 PO6/ PO7/ PO9/ PO10/PO12	PSO1/PSO2/PSO3
UNIT-5	Module-IX Neutral Grounding	Necessity of neutral grounding, various methods of neutral grounding, earthing transformer.	04	PO1/ PO2/ PO3/ PO4/PO5 PO6/ PO7/ PO9/ PO10/PO12	PSO1/PSO2/PSO3
	Module-X EHV AC and HVDC Transmission	Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links, and incorporation of HVDC into AC system.	04	PO1/ PO2/ PO6/ PO8/ PO10/PO12	PSO1/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. To define the power system elements, configurations and types of conductors, type of insulators and their applications. 2. To explain the evolution of power systems and present-day scenario, structure of a power system: bulk power grids and micro-grids, electrostatic and electromagnetic interference with communication lines, phenomenon of corona, corona formation, necessity of neutral grounding, earthing transformer, introduction to EHV ac and HVDC transmission and their comparison, use of bundle conductors. 3. To extend the sources of electric energy: conventional and nonconventional, renewable and non-renewable energy sources, energy storage, sag template, vibration dampers, kinds of dc links, and incorporation of HVDC into ac system, 4. To illustrate the single line diagram of power system, different kinds of supply system and their comparison, choice of transmission voltage, type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables. 5. To apply the Kelvin's law, skin effect, proximity effect, Ferranti effect. surge impedance loading, ABCD, h, image parameters, representation and performance of short, medium and long transmission lines, various methods of neutral grounding. 6. To Solve the inductance and capacitance of single phase, three phase transmission line, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency, catenary curve, calculation of

	sag & tension, effects of wind and ice loading.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	C.L. Wadhwa, Electrical Power Systems, New age international Ltd. Third Edition	2018
2.	Thomas Over by e, J. Duncan Glover, Mulkutla .S. Sarma, Power System: Analysis & Design, C engage Learning India Private Limited.	2011
3.	Prabha Kundur, Power System Stability And Control, McGraw Hill Education	2006
4.	B.R. Gupta, Power System Analysis and Design, Third Edition, S.Chand & Co.	2005
5.	D.P Kothari, I.J Nagrath. Modern Power System Analysis, McGraw Hill Education	2022
6.	D.P Kothari, I.J Nagrath, Power System Engineering | 3rd Edition, McGraw Hill Education	2019
7.	W.D. Stevenson, Element of Power System Analysis, McGraw Hill, USA	1982
8.	S.L. Uppal, Electric Power, Khanna Publishers, India	2013
9.	S.N. Singh, Electric Power Generation, Transmission & distribution, PHI, New Delhi.	1987
10.	Asfaq Hussain, 'Power System, CBS Publishers and Distributors, India.	1982
11.	M.V. Deshpande, Electrical Power System Design, Tata McGraw Hill.	1984

Course Code: BEE-C512
Course Name: Control System

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic Electrical Engineering, Signals & Systems, and Engineering Mathematics.
Objectives:	1. Introduction and Basic concept of control system problem 2. Understand the Time Response Analysis 3. Understand the Frequency-response analysis 4. Introduction to Controller Design 5. Study and Understand the State variable Analysis
Course Coordinator	Mr. Gajendra Singh Rawat

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten(10) short answer type questions of six (06)markeachandstudentshall berequiredtoattemptanyfive(05)questions.Section-Bshallcontaineight(08)longanswer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
UNIT-1	Module-I Introduction to control problem	Industrial Control examples. Mathematical models of physical systems.Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.	09	PO1/ PO6/PO7/PO8/PO9/PO10/PO12	PSO1/ PSO3
UNIT-2	Module-II Time Response Analysis	Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.	08	PO1/ PO2/PO6/PO7/PO8/PO9/PO10/PO12	PSO1/ PSO3
UNIT-3	Module-III Frequency-response analysis	Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.	08	PO1/ PO2/PO3/PO4/PO5/PO6/PO7/PO8/PO9/PO10/PO12	PSO1/ PSO2/PSO3
UNIT-4	Module-IV Introduction to Controller Design	Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specificationsinfrequency-	07	PO1/ PO2/PO3/PO4/PO5/PO6/PO7/PO8/PO9/PO10/PO	PSO1/ PSO2/PSO3

		domain.Frequency-domainmethodsofdesign.ApplicationofProportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.		12	
UNIT-5	Module-V State variable Analysis	Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	08	PO1/ PO2/PO3/PO4/PO5/PO6/PO7/PO8/PO9/PO10/PO12	PSO1/ PSO2/PSO3
Total No. of Hours			40		

Course Outcomes:	1. To define the Industrial Control examples, Concept of Stability, Stability, 2. Explain the Control hardware and their models, Block diagram algebra, Standard test signals, Application of initial and final value theorem, Relative Stability analysis, Polar plots, Bode plots, Nyquist stability criterion, Closed-loop frequency response, steady-state accuracy, transient accuracy, disturbance rejection, Pole-placement by state feedback, Discrete-time systems. Difference Equations. 3. To Illustrate the Time response of first and second order systems for standard test inputs, Routh-Hurwitz Criteria, Relative stability using Nyquist criterion, gain and phase margin, Relationship between time and frequency response, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Analog and Digital implementation of controllers, State-space models of linear discrete-time systems. Stability of linear discrete-time systems, Concepts of state variables 4. To apply the Feedback Control: Open Loop and Closed-loop systems, Benefits of Feedback, Root-Locus technique, Construction of Root-loci, 5. To model the Mathematical models of physical systems, Design specifications for second-order systems based on the time-response 6. To analysis the Transfer function models of linear time-invariant systems, Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design, Lead and Lag compensation in designs, State space model. Diagonalization of State Matrix, Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Suggested Books:

S.No.	Name of Authors /Books /Publisher	Year of Publication
1.	FranklinG.F.,PowellJ.D.,Emami-NaeiniA.,FeedbackControlofDynamicSystems, Pearson,Upper Saddle River, New Jersey, 5th edition, 2006.	2006
2.	BenjaminC.Kuo, AutomaticControl Systems,JohnWileyIndiaPvt.Ltd.,8th Edition.	2008
3.	Ashfaq Husain, HarroonAshfaq, Control Systems, Dhanpat Rai & Co. (P) Limited	2016
4.	OgataK.,ModernControlEngineering,Prentice-HallofIndiaPvtLtd.,NewDelhi,3rd edition.	2000

Course Code:BEE-C513
Course Name: Electrical Drives& Their Control

MM:100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit:3**

Prerequisites:	Electrical Machines, Power Electronics, Control Systems.
Objectives:	1. To impart knowledge about fundamentals of Electric drives and control. 2. Operational strategies of dc and ac motor drives as per different quadrant operations and to discuss. 3. To develop a deep understanding of advanced electric drive systems and their control. 4. To explore power electronic converters used for drive applications. 5. To study performance characteristics of AC and DC motor drives under dynamic conditions.
Course Coordinator	Mr. AviralAwasthi

Note:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) marks each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Unit	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
UNIT-1	Module-I Fundamentals of Electric Drive	Electric Drives and its parts, Advantages of Electric Drive, Classification of Electric Drives, Speed-torque conventions and multi-quadrant operations, Constant torque and Constant power operation, Types of load, Load Torque: components, nature and classification.	08	PO1/PO2/PO3/PO10	PSO1/PSO2
UNIT-2	Module-II Dynamics of Electric Drives	Fundamental torque equation, Equivalent Values of Drive Parameters, classes of motor duty, Thermal model of motor for heating and cooling, Steady states stability of electric drives, transient stability of electric drives.	08	PO1/PO2/PO10	PSO1
UNIT-3	Module-III Electric Braking	Purpose and types of electric braking, braking of dc, Three phase induction motor. Dynamics during Starting and breaking: Calculation of acceleration time and energy loss during starting of dc shunt and 3-phase induction motors, Method of reducing energy loss during starting. Energy relation during braking, Dynamics during braking	08	PO1/PO2/PO4/PO10	PSO1

UNIT-4	Module-IV Power Electronic Control of DC Drives	Single phase and three phase controlled converter feed separately excited dc motor drives (continuous conduction only), dual controlled converter feed separately excited dc motor drives, Chopper control of separately excited dc motor and dc series motor.	08	PO1/PO2/PO3/PO4/PO10	PSO1/PSO3
UNIT-5	Module-V Power Electronic Control of AC Drives	Three phase induction motor drive: static voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based), slip power recovery control schemes, Three Phase Synchronous Motors: Self-control schemes, Special Drivers: Switched Reluctance motor, Brushless dc motor.	08	PO1/PO2/PO3/PO4/PO6/PO11	PSO1/PSO2/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Analyze the dynamics and torque-speed characteristics of electric drives. 2. Develop control strategies for efficient operation of DC and AC drives. 3. To estimate & solve harmonic and power factor related problems in controlling AC and DC drives. 4. Analyze the dynamics and torque-speed characteristics of electric drives. 5. Develop control strategies for efficient operation of DC and AC drives. 6. Design and implement advanced control for induction and synchronous motors.

Suggested Books:

S.No.	Name of Authors /Books / Publisher	Year of Publication
1.	G.K.Dubey, Fundamentals of Electrical Drives, Narosa.	2002
2.	S.K.Pillai, A First course on electric drives, New age international	1989
3.	S.L.Uppal, Electrical Power, Khanna Publishers, New Delhi	1992
4.	R.Krishnan, Electrical Motor Drives, PHI	2003
5.	G.K.Dubey, Power Semi- conductor controlled drives, Prentice Hall	1989
6.	S.A.Nasar, Boldea, Electrical Drives, Second Edition, CRC Press	2006
7.	M.A.Elsharkawi, Fundamentals of Electrical Drives, Thomson Learning	2000
8.	VedamSubrahmaniam, Electric Drives, TMH	2013

Course Code: BEE-M 001
Course Name: Universal Human Values

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Openness to self-reflection, willingness to understand life and relationships.
Objectives:	1. To help students understand the need, basic guidelines, content and process for value education. 2. To develop a holistic perspective towards life, profession, and happiness. 3. To make students sensitive to the role of relationships and human values in real life. 4. To prepare engineers who can integrate technical competence with ethical responsibility. 5. To enable students to evaluate their role as responsible engineers and citizens, ensuring that technological growth aligns with ethical, cultural, and societal well-being.
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten(10) short answer type questions of six(06) mark each and student shall be required to attempt any five(05) questions. Section-B shall contain eight(08) longanswer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
UNIT-1	Module-I Introduction to Human Values	Need, basic guidelines, and content of value education, Concept of natural acceptance, Human aspirations and happiness, Difference between animal and human consciousness, Self-exploration: Purpose and process	08	PO6/PO7/PO8/PO12	PSO3
UNIT-2	Module-II Understanding Harmony in the Human Being	Understanding the human being as co-existence of self ('I') and body, Needs of self and needs of body, Body as an instrument of 'I', Harmony of self with the body – Sanyam and Swasthya, Exploring happiness and prosperity within the individual	08	PO6/PO7/PO8	PSO2/PSO3
UNIT-3	Module-III Harmony in Human Relationships	Values in relationships – respect, trust, gratitude, affection, love, Nine universal values in relationships, Exploring the meaning of justice in human relationships, Trust as the foundation of relationships, Concept of family as the basic unit of human interaction	08	PO6/PO7/PO11	PSO3
UNIT-4	Module-IV Harmony in Nature and Existence	Interconnectedness of all units in nature, Four orders of nature – material, plant, animal, and human, Concept of balance and co-existence, The role of humans in ensuring ecological harmony,	08	PO6/PO7/PO8/PO12	PSO1/PSO3

		Sustainability and responsibility towards environment			
UNIT-5	Module-V Holistic Living and Professional Ethics	Holistic understanding of harmony at all levels of existence, Ethical human conduct and professional ethics, Role of universal human values in society and business, Vision of a universal human order – from family to world family, Case studies: Ethical dilemmas in engineering practice	08	PO6/PO7/PO8/PO11/PO12	PSO2/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Understand the need and process for value-based living. 2. Develop clarity in human aspirations, harmony, and ethical living. 3. Demonstrate respect and trust in human relationships. 4. Analyze the interconnection between humans, nature, and existence. 5. Apply universal human values in personal life, professional practice, and societal well-being.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	R.R. Gaur, R. Sangal, G.P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books	2010
2.	E.F. Schumacher, Small is Beautiful, Harper Perennial	1993
3.	A.N. Tripathi, Human Values, New Age International	2009
4.	S. K. Chakraborty, Foundations of Managerial Work – Contributions from Indian Thought, Himalaya Publishing	1998
5.	S. K. Chakraborty, Values & Ethics for Organizations: Theory and Practice, Oxford University Press	2001

Course Code: BCE-P515
Course Name: Object Oriented Programming Using C++

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basics of Computers.
Objectives:	1. Introduction to Object oriented Paradigm. 2. Features of object-oriented programming, class and object: state, identity, and behavior 3. Data Abstraction and Data Hiding 4. Encapsulation, Inheritance and polymorphism. 5. Inheritance in OO design. 6. Implementing OO language features. 7. Memory management. 8. Generic types and collections
Course Coordinator	Dr. AmanTyagi

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
UNIT-1	Module-I Introduction & Class Overview	Review of C, Difference between C and C++, Cin, Cout, new, delete operators, abstraction, encapsulation, inheritance, polymorphism, Structured versus object-oriented development, elements of object oriented programming. Class specification, class objects, accessing class members, defining member functions, outside member functions as inline, accessing member functions within a class, data hiding, access boundary of objects revisited, empty classes, pointers within a class, passing objects as arguments, returning objects from functions, friend functions and friend classes, constant parameters and member functions, structures and classes, static data and member functions, class, objects and memory resource, class design steps.	08	PO6/PO7/PO8/PO12	PSO3
UNIT-2	Module-II Object Initialization and Cleanup	Class revisited, constructors, parameterized constructors, destructor, constructor overloading, order of construction and destruction, constructors with	08	PO6/PO7/PO8	PSO2/PSO3

		default arguments, copy constructor, static data members with constructors and destructors. Introduction, over loadable operators, unary operator overloading, operator keyword, operator return values, limitations of increment/decrement operators, binary operator overloading, arithmetic operators, data conversion, conversion between basic data types, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions.			
UNIT-3	Module-III Inheritance	Introduction, class revised, derived class declaration, forms of inheritance, inheritance and member accessibility, constructors in derived classes, destructors in derived classes, constructors invocation and data members initialization, overloaded member functions, multilevel inheritance, multiple inheritance, hierarchical inheritance, multipath inheritance and virtual base classes, hybrid inheritance.	08	PO6/PO7/PO11	PSO3
UNIT-4	Module-IV Virtual Functions and Classes&Generic Programming with Templates	Interconnectedness of all units in nature, Four orders of nature – material, plant, animal, and human, Concept of balance and co-existence, The role of humans in ensuring ecological harmony, Sustainability and responsibility towards environment. Introduction, function templates, overloaded function templates, multiple arguments function templates, user defined template arguments,class templates.	08	PO6/PO7/PO8/PO12	PSO1/PSO3
UNIT-5	Module-V Stream Computation with Files &Exception Handling	Introduction, hierarchy of file stream classes, opening and closing of files, file modes, file pointers, sequential access to a file, saving and retrieving of objects, file input/output with stream class. Introduction, error handling, exception handling model, exception handling constructs.	08	PO6/PO7/PO8/PO11/PO12	PSO2/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Specify simple abstract data types and design implementations, using abstraction functions to document them. 2. Recognize features of object-oriented design such as encapsulation, polymorphism, Inheritance. 3. Name and apply some common object-oriented design patterns and give examples of their use. 4. Prepare for competitive programming by implementing the concepts learned

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	E. Bala guru samy, Object Oriented Programming with C++, TMH	Latest
2.	S. B.Lippman& J. Lajoie, C++ Primer, Addison Wesley	Latest
3.	G. Booch, Object Oriented Design & Applications, PHI	Latest

Course Code: BEE-P 516
Course Name: Energy Audit

MM:100 **Time:4 Hr.** **L TP** **30 0**	**Sessional: 30** **ESE: 70** **Credit: 0**

Prerequisites:	Knowledge of Electrical Machines, Power Systems, and Energy Management Basics.
Objectives:	1. To understand the need and importance of energy auditing in industries and commercial buildings. 2. To develop capability in identifying energy saving opportunities through audits. 3. To learn methods, tools, and instruments used in energy auditing. 4. To introduce the process of audit reporting, compliance, and economics of energy saving. 5. To provide an understanding of energy systems and the need for energy management.
Course Coordinator	Mr. Lokesh Bhardwaj

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	Posmapped	PSOs mapped
UNIT-1	Module-I Basics of Energy Auditing	Introduction to Energy Audit – Definition and scope, Types of energy audit – Preliminary and Detailed, Need for energy audit and energy conservation, Roles and responsibilities of an Energy Auditor, Energy scenario: global and Indian perspective	08	PO6/PO7/PO 11	PSO2
UNIT-2	Module-II Energy Audit Methodology	Energy audit methodology and phases, Walk-through audit and checklist, Data collection and energy flow diagram, Load analysis and energy use index (EUI), Case study-based approach	08	PO1/PO2/PO 6/PO10	PSO1/PSO2
UNIT-3	Module-III Tools and Instrumentation	Instruments for measuring electrical parameters: power analyzer, data logger, lux meter, IR thermometer, etc., Instrument calibration and accuracy, Measurement of temperature, airflow, lighting levels, Smart meters and IoT-based audit tools, Safety precautions during audit	08	PO2/PO4/PO 6/PO10	PSO1/PSO3
UNIT-4	Module-IV Sector-Specific Energy	Electrical system audit: transformers, motors, power factor, harmonics, Lighting system audit, HVAC and compressed air system audit, Boiler	08	PO2/PO4/PO 6/PO8	PSO1/PSO3

	Auditing	and steam system audit (brief), Case studies from commercial and industrial sectors			
UNIT-5	Module-V Energy Economics and Audit Reporting	Cost-benefit analysis and financial indicators: ROI, NPV, IRR, Payback period, Life Cycle Cost Analysis (LCCA), Preparation and structure of audit report, Post-audit implementation and monitoring, Legal and regulatory aspects	08	PO6/PO8/PO 11/PO12	PSO2/PSO3
Total No. of Hours			**40**		
Course Outcomes:	1. Understand the concept, scope, and types of energy audits. 2. Perform step-by-step energy audits using proper methodology and data analysis. 3. Operate and apply audit instruments for various measurements. 4. Evaluate energy performance of different systems in industrial and commercial sectors. 5. Analyze financial viability of energy-saving measures and prepare detailed audit reports.				

Suggested Books:

S.No.	Name of Authors/Books/Publisher	Year of Publication
1.	Bureau of Energy Efficiency, Energy Manager Guide Book Vol. I-IV	Latest
2.	Sonal Desai, Handbook of Energy Audit, McGraw-Hill	2021
3.	C.B. Smith, Energy Management Principles, Pergamon Press	2015
4.	S. Audin, Electrical Systems and Energy Auditing, CRC Press	2012
5.	Albert Thumann, Handbook of Energy Audits, Fairmont Press	2016

Course Code: BEE-O 517
Course Name: Industrial Electrical Systems

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Electrical Engineering, Electrostatics
Objectives:	1. To understand the electrical wiring systems for residential, commercial, and industrial consumers. 2. To represent electrical systems with standard symbols and drawings, including Single Line Diagrams (SLD). 3. To understand various components of industrial electrical systems. 4. To analyze and select the appropriate size for various electrical system components. 5. To gain knowledge of electrical wiring systems for residential and industrial electrical system components.
Course Coordinator	Mr. Gaurav Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Electrical System Components	LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current,	06	PO1/PO2/ PO4/PO5/ PO6	PSO1/ PSO2/PS O3
	Module-II Electrical Installation	Characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	04	PO1/ PO2/PO6	PSO1/PS O2
UNIT-2	Module-III Residential and Commercial Electrical Systems	Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation,	06	PO1/ PO2/PO4/ PO6	PSO1/ PSO2/PS O3
UNIT-3	Module-IV Industrial Electrical Systems I	HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning	06	PO1/ PO2/PO5/ PO6	PSO1/PS O2

		Protection, Earthing design, Power factor correction kVAR calculations, type of compensation.			
UNIT-4	Module-V Industrial Electrical Systems II	Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components, DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	07	PO1/PO4/ PO5/PO6	PSO1/ PSO2
UNIT-5	Module-VI Industrial Electrical System Automation	Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.	11	PO1/PO5/ PO6	PSO1
Total No. of Hours			40		

Course Outcomes:	1. The Student Analyse and select the proper size of various electrical system components 2. Knowledge of electrical wiring systems for residential, components of industrial electrical systems. 3. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD. 4. Understand various components of industrial electrical systems. 5. Analyse and select the proper size of various electrical system components.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	S.L Uppal and G.C Garg, "Electrical Wiring Estimation and Costing", Khanna publishers, 6th Edition, ISBN 81-7409-240-4	1987
2.	TejpalYogeshKharche, "Industrial Electrical Systems (IES)" Notion Press, 1st Edition, ISBN 9798888834220.	2023
3.	B. P. Patil and M.A Chaudhari "Industrial Electrical Systems – I", Nirali Publication, 2nd Edition ISBN 978-81-203-3569-1	2008

Course Code: BEE-O 518
Course Name: Sensor and Transducers

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Electrical Engineering, Electrostatics, Electromagnetism
Objectives:	1. To familiarize students with the construction and operating principles of various sensors and transducers. 2. To educate students about measuring instruments, measurementmethods, and the application of different transducers. 3. To enable students to remember and understand the fundamentalprinciples of transducers and smart sensors. 4. To help students apply their knowledge of transducers and sensorsto comprehend digital instrumentation systems. 5. To provide students with the ability to analyze and evaluate theperformance of different sensors for various applications
Course Coordinator	Mr.Gaurav Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction Mechanical and Electromechanical sensor	Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor variation with temperature, adhesive, rosettes	06	PO1/PO2/ PO4/PO5/ PO6	PSO1/ PSO2/PSO 3
	Module-II Inductive sensor	common types Reluctance change type, Mutual inductance change type, transformer action type, Magneto strictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis.	04	PO1/ PO2/PO6	PSO1/PSO 2
UNIT-2	Module-III Capacitive sensors	Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric	06	PO1/ PO2/PO4/ PO6	PSO1/ PSO2/PSO 3

		constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics.			
UNIT-3	Module-IV Piezoelectric element	piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors	06	PO1/ PO2/PO5/ PO6	PSO1/PSO 2
UNIT-4	Module-V Thermal sensors	**:** Material expansion type: solid, liquid, gas &vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermoemf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison.	05	PO1/PO4/ PO5/PO6	PSO1/ PSO2
UNIT-5	Module-VI Magnetic sensors	Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.	08	PO1/PO5/ PO6	PSO1
	Module-VII Radiation sensors	LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors	05	PO1/PO5/ PO6	PSO1
Total No. of Hours			**40**		

Course Outcomes:	1. Remember and understand the basic principles of transducers and smart sensors. 2. Apply the knowledge of transducers and sensors to comprehend digital instrumentation systems. 3. Analyze and evaluate the performance of different sensors for various applications. 4. Design and create a system using appropriate sensors for a particular application 5. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	A.K. Sawhney "Electrical and Electronic Measurements and Instrumentation", DhanpatRai and Sons, 18th Edition, ISBN 81-7700-016-0	2008
2.	Clarence W.de Silva, "Sensor systems: Fundamentals and applications" CRC Press,Edition, ISBN 9781498716246.	2016

3.	D.V.S. Murthy “Transducers and Instrumentation”, PHI Publication, 2nd Edition ISBN 978-81-203-3569-1	2008

POWER SYSTEM- I LABORATORY

BEE-C 561

MM: 50
Time: 2 Hr
L T P
0 0 2

Sessional: 15
ESE: 35
Credit: 1

LIST OF EXPERIMENTS

1. To study the performance of a long transmission line under no load & light load conditions.
2. To study phase displacement between the current & voltage at input of line using transmission line trainer kit.
3. Measurement of input impedance and attenuation of transmission line using transmission line trainer kit.
4. Measurement of characteristics of transmission using transmission line trainer kit.
5. To find the resistivity of the earth using a hand driven earth tester.
6. To study the performance characteristics of a typical D.C. distribution system (Radial Configuration).
7. To determine the ABCD parameters of transmission line.
8. To determine the h parameters and Image parameters of transmission line.
9. To study the voltage distribution across a string insulator and calculate string efficiency.
10. To test the breakdown voltage of the transformer oil by transformer oil testing set.

Note: Below experiments are to be performed using Virtual Labs (An initiative of the Ministry of Education, Government of India). (5 Experiments are Compulsory)

1. To study the Synchronization of alternator with infinite bus bar.
2. To determine the direct axis reactance (X_d) and quadrature axis reactance (X_q) of synchronous machine.
3. To determine positive sequence, negative sequence and zero sequence reactances of an alternator.
4. To measure the dielectric Strength of transformer oil.
5. To Study the effect of different shape of electrodes on dielectric (air) breakdown.
6. To Study the gas actuated Buchholz relay for oil filled transformer.
7. To Study the over-current relay and the effect of PSM and TSM.
8. To determine the sub-transient (x_d''), transient (x_d') and steady state reactance (x_d) of a synchronous machine.
9. To Study the Ferranti Effect of a transmission line/cable.
10. To study the differential Protection of a three phase delta-delta connected transformer.
11. To study the Protection of a three phase Induction Motor using Numerical Relay.

CONTROL SYSTEM LABORATORY

BEE-C 562

MM: 50
Time: 2 Hr
L T P
0 0 2

Sessional: 15
ESE: 35
Credit: 1

LIST OF EXPERIMENTS

1. To study the performance of various types of controllers (P, PI, PID) used to control the temperature of an oven & find
   (a) Open loop response of oven & its transfer function
   (b) Closed loop response of oven using P, PI and PID controller.
2. To study the performance characteristics of DC motor angular position control system.
3. To study the performance characteristics of DC motor angular position error detector using potentiometer.
4. To study the Linear Variable Differential Transformer (LVDT) & draw its characteristic.
5. To study the performance of Strain Gauge & draw the following characteristics:
   (a) Strain vs. Weight
   (b) Strain vs. Strain Gauge Resistance
6. To study the performance of Resistance Temperature Detector (RTD) & draw the following characteristics:
   (a) Time vs. Temperature (for heating)
   (b) Time vs. Temperature (for cooling)
   (c) Temperature vs. Resistance of RTD
7. To study the performance characteristics of analog P, PI and PID controllers on the simulated system.
8. To study the configuration and evaluate the performance characteristics of a feedback light control system.
9. To study digital control of a simulated system using a 6 bit microprocessor.
10. Study of the characteristics of Linear System Simulator trainer kit.

Note: Below experiments are to be performed using Virtual Labs (An initiative of the Ministry of Education, Government of India). (5 Experiments are Compulsory)

1. Pole-zero plot
2. First order unity feedback
3. Second order unity feedback system
4. Type zero-one-Two System
5. Study the effect of addition of zeros to the forward path transfer function of a closed loop system
6. Study the effect of addition of poles to the forward path transfer function of a control system
7. To obtain root locus for a given transfer function of the system
8. To obtain bode plot for a given transfer function of the system
9. Nyquist plot of a second order system
10. To study the effect of PI, PD and PID controller on a control system

ELECTRICAL DRIVES LABORATORY

BEE-C 563

MM: 50 **Sessional: 15**
Time: 2 Hr **ESE: 35**
L T P **Credit: 1**
0 0 2

LIST OF EXPERIMENTS

1. Performance & speed control of D.C. drive using 3-phase full Converter.
2. To perform speed control of separately excited dc motor using chopper.
3. Speed control of dc motor using closed loop and open loop.
4. Study and analyze the performance of four quadrant operation of chopper fed dc motor drive at different firing angles.
5. Determination of speed and output voltage of 3-phase A.C. Voltage controller fed induction motor drive.
6. Performance & speed control of 3-phase slip ring Induction motor by Static Rotor Resistance controller.
7. DSP based V/F Control of 3-phase Induction motor.
8. DSP based Speed control of BLDC motor.
9. Study of Chopper fed DC Drive.
10. Study of AC Single phase motor-speed control using TRIAC.

Note: Below experiments are to be performed using Virtual Labs (An initiative of the Ministry of Education, Government of India). (5 Experiments are Compulsory)

1. Introduction to PLC and Introduction to digital I/O interface to PLC
2. Introduction to ladder logic
3. PLC On-Delay Timer Instruction
4. PLC Off-Delay Timer Instruction
5. PLC Retentive Timer On Instruction
6. PLC Count-Up instruction
7. PLC Count-Down instruction
8. Garage Shutter Opening and Closing Using PLC
9. Container Filling Process Using PLC
10. Simultaneous output interlock using PLC
11. Maximum Simultaneous Operations Limiter using PLC
12. Motor forward and reverse direction control using PLC

Revised Syllabus (Effective from the session 2025-26)

Gurukula Kangri (Deemed to be University), Haridwar
Faculty of Engineering & Technology
B. Tech. Electrical Engineering

Third Year **Semester-VI**

S. No	COURSE CODE	COURSE TITALE	PERIODS			EVALUATION SCHEME				SUBJECT TOTAL
						SESSIONAL EVALUATION			ESE	
THEORY										
			L	**T**	**P**	**CREDIT**	**CT**	**TA**	**TOTAL**		
1	BEE-C 611	Power System-II	3	0	0	3	20	10	30	70	100
2	BEE-C 612	Computer Aided Design of Electrical Machines with Programming	3	0	0	3	20	10	30	70	100
3	BET-C 613	Microprocessors and Interfacing	3	0	0	3	20	10	30	70	100
4	BEE-C 614	Generation of Electrical Energy	3	0	0	3	20	10	30	70	100
5	BEE-P XXX	Program Elective-II	3	0		3	20	10	30	70	100
6	BEE-O XXX	Open Elective-II	3	0	0	3	20	10	30	70	100
PRACTICAL											
7	BEE-C 661	Power System-II Laboratory	0	0	2	1	10	05	15	35	50
8	BEE-C 662	Computer Aided Design of Electrical Machine Laboratory	0	0	2	1	10	05	15	35	50
9	BET-C 666	Microprocessors and Interfacing Laboratory	0	0	2	1	10	05	15	35	50
TOTAL			**18**	**0**	**6**	**21**	**150**	**75**	**225**	**525**	**750**

Program Elective-II

1. BEE-P 615 Digital Control System
2. BEE-P 616 Fundamentals of Drone Technology

Open Elective-II

1. BEE-O 617 Fundamentals of AI
2. BEE-O 618 Soft Computing

L	**Lecture**	**T**	Tutorial	**C**	Discipline Specific Course
CT	Cumulative Test	**TA**	Teacher Assessment	**ESE**	End Semester Examination
BEE	Electrical Code	**O**	Open Elective	**P**	Program Elective

Course Code: BEE-C 611
Course Name: Power System -II

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Electrical Machines, Power Systems-I
Objectives:	1. Representation of power system components, Symmetrical components, Symmetrical and Unsymmetrical fault analysis. 2. The problem and solution of Load Flows. 3. Stability in Power System. 4. Travelling Waves in Power System 5. Overview of Energy Control Centre Functions.
Course Coordinator	Dr. Ashish Dhamanda

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Representation of Power System Components	Synchronous machines, Transformers, Transmission lines, Impedance and reactance diagram. Per Unit System, Changing the base of per unit quantities, Advantages of per unit system.	04	PO1/ PO2/ PO3/ PO4 PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 3
	Module-II Symmetrical components	Symmetrical Components of unbalanced pharos, power in terms of symmetrical components, sequence impedances and sequence networks.	03	PO1/ PO2/ PO3/ PO4 PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 3
UNIT-2	Module-III Symmetrical fault analysis	Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions.	04	PO1/ PO2/ PO3/ PO4 PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3
	Module-IV Unsymmetrical faults	Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance.	04	PO1/ PO2/ PO3/ PO4/PO5/ PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3

UNIT-3	Module-V Load Flows	Load flow Introduction, bus classifications in details, Bus admittance matrix (Y Bus), development of load flow equations, load flow solution using Gauss Seidel and Newton-Raphson method, approximation to N-R method, line flow equations and fast-decoupled method, Economic dispatch and optimal power flow.	08	PO1/ PO2/ PO3/ PO4/PO5/ PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3
UNIT-4	Module-VI Stability in Power System	Stability and Stability limit, Steady state stability study, Swing Equations of asynchronousmachine,Poweranglecurve,andequalareacriterion,transientstabilitystudybyequalarea Criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement.	08	PO1/ PO2/ PO3/ PO4/PO5/ PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3
UNIT-5	Module-VII Travelling Waves in Power System	Wave equation for uniform Transmission lines, velocity of propagation, Lightning and switching surges, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewley lattice diagram, protection of equipment and line against traveling waves.	05	PO1/ PO2/ PO3/ PO4 PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3
	Module-VIII Overview of Energy Control Centre Functions	SCADA systems, Preventive Control and Emergency Control.	04	PO1/ PO2/ PO3/ PO4/PO5/ PO6/ PO7/ PO8/ PO9/ PO10/ PO11/PO12	PSO1/PSO 2/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. To define the Synchronous machines, Transformers, Transmission lines, Load Flow, Stability, Wave equation for uniform Transmission lines, velocity of propagation. 2. Explain the Impedance and reactance diagram, Per Unit System, Symmetrical Components of unbalanced phasors, Transient in R-L series circuit, bus classifications, Bus admittance matrix, Stability limit, Steady state stability study, Swing Equations of a synchronous machine. 3. To Illustrate the Advantages of per unit system, Economic dispatch and optimal power flow, Power angle curve and equal area criterion, reflection and transmission of traveling waves under different line loadings, Bewley lattice diagram. 4. To apply the Changing, the base of per unit quantities, power in terms of symmetrical components, calculation of 3-phase short circuit current and reactance of synchronous machine, development of load flow equations, transient stability

	study by equal area criterion and step-by- step method, protection of equipment and line against traveling waves. 5. To solve the load flow solution using Gauss Seidel and Newton-Raphson method, approximation to N-R method, line flow equations and fast-decoupled method 6. To analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generator, power system network with and without fault impedance, load flow solution using Gauss Seidel and Newton-Raphson method, approximation to N-R method, line flow equations and fast-decoupled method, Factors affecting steady state and transient stability and methods of improvement, SCADA systems, Preventive Control and Emergency Control.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	D.P Kothari, I.J Nagrath. Modern Power System Analysis, McGraw Hill Education	2022
2.	D.P Kothari, I.J Nagrath, Power System Engineering | 3rd Edition, McGraw Hill Education	2019
3.	W.D. Stevenson, Element of Power System Analysis, McGrawHill, USA	1982
4.	C.L. Wadhwa, Electrical Power Systems, New age international Ltd.Third Edition	2018
5.	S.L. Uppal, Electric Power, Khanna Publishers, India	2013
6.	S.N. Singh, Electric Power Generation, Transmission & distribution, PHI, New Delhi.	1987
7.	Asfaq Hussain,' Power System, CBS Publishers and Distributors, India.	1982
8.	B.R. Gupta, Power System Analysis and Design, Third Edition, S.Chand & Co.	2005
9.	M.V. Deshpande, Electrical Power System Design, Tata McGrawHill.	1984
10.	Thomas Overbye, J. Duncan Glover, Mulkutla .S. Sarma, Power System: Analysis & Design, Cengage Learning India Private Limited.	2011
11.	Prabha Kundur, Power System Stability And Control, McGraw Hill Education	2006

Course Code: BEE-C 612
Course Name: Computer Aided Design of Electrical Machines with Programming

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE:70** **Credit :3**

Prerequisites:	Electrical Machine-I, Electrical Machine-II, Knowledge of MATLAB
Objectives:	By the end of this section, you will be able to: 1. Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques. 2. Classification of insulating materials. Modes of heat dissipation & temperature rise-time curves. Methods of cooling ventilation. 3. Design of Electrical Machines of Transformer, Rotating Machines etc. with flow charts. 4. Computer aided design approaches analysis, synthesis and hybrid methods, Concept of optimization and its general procedure.
Course Coordinator	Mr. Gajendra Singh Rawat

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten(10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Basic Considerations	Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques. Classification of insulating materials. Modes of heat dissipation & temperature rise-time curves. Methods of cooling ventilation (induced &forced, radial & axial), direct cooling & quantity of cooling medium. Calculation of total mmf and magnetizing current. Specific permeance and leakage reactance. Electrical Materials: Crystal structures and defects, ceramic materials, insulating materials, magnetic materials basics, properties and applications; ferrites, Ferro-magnetic materials and components; Basics of Nano materials and Superconductors.	09	PO1/ PO6/PO7/PO 8/PO9/PO10/ PO12	PSO1/ PSO3
UNIT-2	Module-II Transformer Design	Output equation design of core, yoke and windings, overall dimensions, Computation of no-load current to voltage regulation, efficiency and cooling system designs.	08 –	PO1/ PO2/PO6/PO 7/PO8/PO9/P O10/PO12	PSO1/ PSO3

UNIT-3	Module-III Design of Rotating Machines I	Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size. Core and armature design of dc and 3-phase AC machines.	08	PO1/ PO2/PO3/PO 4/PO5/PO6/P O7/PO8/PO9 /PO10/PO12	PSO1/ PSO2/PS O3
UNIT-4	Module-IV Design of Rotating Machines II	Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines. Estimation of performance from design data.	07	PO1/ PO2/PO3/PO 4/PO5/PO6/P O7/PO8/PO9 /PO10/PO12	PSO1/ PSO2/PS O3
UNIT-5	Module-V Computer Aided Design	Philosophy of computer aided design, advantages and limitations. Computer aided design approaches analysis, synthesis and hybrid methods, Concept of optimization and its general procedure. Flow charts for the design of transformer, dc machine, three-phase induction and synchronous machines.	08	PO1/ PO2/PO3/PO 4/PO5/PO6/P O7/PO8/PO9 /PO10/PO12	PSO1/ PSO2/PS O3
Total No. of Hours			**40**		

Course Outcomes:	1. To Define the Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques, 2. To Explain Classification of insulating materials. Modes of heat dissipation & temperature rise-time curves, Crystal structures and defects, ceramic materials, insulating materials, magnetic materials, Philosophy of computer aided design, advantages and limitations. 3. To Extend the ferrites, Ferro-magnetic materials and components; Basics of Nano materials and Superconductors, Computer aided design approaches analysis, synthesis and hybrid methods. 4. To Illustrate the Methods of cooling ventilation (induced & forced, radial & axial), direct cooling & quantity of cooling medium, Concept of optimization and its general procedure. 5. To Apply the Calculation of total mmf and magnetizing current. Specific permeance and leakage reactance, Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size, Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines, Flow charts for the design of transformer, dc machine, three-phase induction and synchronous machines. 6. To Analyze the Computation of no-load current to voltage regulation, efficiency and cooling system designs, Core and armature design of dc and 3-phase AC machines, Estimation of performance from design data.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	A.K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & Sons.	2016
2.	M.G. Say, The Performance and Design of AC Machines, Pitman & Sons.	2008
3.	S.K. Sen, Principle of Electrical Machine Design with Computer Programming, Oxford and IBM Publications.	2014

4.	Siskind, Electrical Machine Design McgrawHill	1954

Course Code: BET-C 613
Course Name: Microprocessors and Interfacing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE:70** **Credit :3**

Prerequisites:	Digital Electronics, Basic Computer Organization, and Assembly Programming concepts.
Objectives:	1. To introduce the architecture, organization, and functioning of microprocessors. 2. To develop skills in low-level assembly programming and debugging. 3. To understand memory interfacing, peripheral interfacing, and bus structures. 4. To provide knowledge of interrupt handling, DMA, and interfacing devices. 5. To prepare students for embedded systems, robotics, and real-time application development.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction to Microprocessors	Evolution of microprocessors, comparison of 8-bit, 16-bit, and 32-bit processors, Microprocessor organization: ALU, CU, registers, buses, and flags, Overview of 8085 architecture and pin configuration, Instruction cycle, machine cycle, and timing diagrams, Addressing modes and data transfer mechanisms	08	PO1/PO6	PSO1
UNIT-2	Module-II Programming with 8085/8086	Instruction set classification: data transfer, arithmetic, logical, branching, control, Assembly language programming basics, Programs for arithmetic operations, code conversion, and counters, Overview of 8086 architecture and instruction set, Debugging and simulation tools for assembly programming	08	PO1/PO2/PO4	PSO2
UNIT-3	Module-III Memory and I/O Interfacing	Memory classification and hierarchy, Interfacing RAM and ROM with microprocessors, I/O mapped I/O and memory-mapped I/O concepts, Bus structure: data bus, address bus, and control bus, Interfacing with 8255 (Programmable Peripheral Interface)	08	PO2/PO4/PO10	PSO1/PSO3
UNIT-4	Module-IV Interrupts and DMA	Interrupt structure of 8085 and 8086, Types of interrupts: hardware, software, vectored, non-	08	PO2/PO4/PO6/PO10	PSO2/PSO3

		vectored, Interrupt handling and service routines, Direct Memory Access (DMA) and controller 8257, Applications of interrupts and DMA in real-time systems			
UNIT-5	Module-V Interfacing Devices and Applications	Interfacing with 8253 (Programmable Interval Timer) and 8259 (Interrupt Controller), Interfacing ADC/DAC with microprocessor, Serial communication interface (USART 8251), Case studies: microprocessor-based data acquisition systems, motor control, and instrumentation, Emerging trends: microcontrollers vs microprocessors in embedded applications	08	PO6/PO7/PO 8/PO12	PSO1/PS O3
Total No. of Hours			**40**		

Course Outcomes:	1. Explain the architecture, instruction set, and functioning of 8085 and 8086 microprocessors. 2. Write and execute assembly language programs for arithmetic, logical, and control operations. 3. Interface memory and I/O devices with microprocessors. 4. Analyze interrupt structures and DMA mechanisms for efficient data handling. 5. Apply microprocessor interfacing techniques for real-world applications in embedded systems.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International	2013
2.	Douglas V. Hall, Microprocessors and Interfacing, McGraw-Hill	2017
3.	A.K. Ray & K.M. Bhurchandi, Advanced Microprocessors and Peripherals, McGraw-Hill	2014
4.	Kenneth Ayala, The 8086 Microprocessor: Programming and Interfacing, Delmar	2007
5.	Brey Barry, Intel Microprocessors: Architecture, Programming, and Interfacing, Pearson	2017

Course Code: BEE-C 614
Course Name: Generation of Electrical Energy

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE:70** **Credit :3**

Prerequisites:	Basic Electrical Engineering, Power Systems, Electrical Machines.
Objectives:	By the end of this section, you will be able to: 1. To impart knowledge of conventional and non-conventional methods of electrical power generation. 2. To enable students to analyze the working principles, layout, and operation of different power plants. 3. To understand economic, environmental, and technical aspects of power generation. 4. To provide insight into modern technologies like renewable energy integration and smart generation. 5. To prepare students for industry practices, research, and higher studies in the field of energy and power systems.
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten(10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction to Power Generation	Energy resources and their classification, Indian and world energy scenario, Conventional vs non-conventional energy sources, Overview of power generation methods, Role of power sector in national development	08	PO1/PO6/PO7	PSO1
UNIT-2	Module-II Conventional Power Plants	**Thermal Power Plants:** layout, working principle, major equipment (boiler, turbine, condenser, generator) **Hydro Power Plants:** site selection, classification, layout, pumped storage **Nuclear Power Plants:** nuclear fission, reactor types, safety measures Comparative analysis of thermal, hydro, and nuclear plants	08	PO1/PO2/PO4/PO6	PSO1/PSO2
UNIT-3	Module-III Non-Conventional and Renewable Energy Sources	Solar energy: PV systems, solar thermal power plants Wind energy: site selection, wind turbines, grid integration Biomass, geothermal, tidal, and fuel cell power generation Small hydro and hybrid energy systems Challenges in renewable energy integration	08	PO6/PO7/PO8/PO12	PSO2/PSO3

UNIT-4	Module-IV Economics of Power Generation	Load curve, load duration curve, plant load factor, capacity factor, Cost of generation: fixed and variable cost, depreciation, Tariff methods: flat rate, block rate, two-part tariff, Economic load dispatch and unit commitment (introductory concepts), Environmental and policy aspects in energy generation	08	PO2/PO4/PO6/PO11	PSO1/PSO3
UNIT-5	Module-V Modern Trends in Power Generation	Distributed generation and microgrids, Smart grid integration of renewable energy, Cogeneration and combined cycle power plants, Energy storage systems in power generation, Future of energy: hydrogen economy, green energy initiatives	08	PO2/PO6/PO7/PO12	PSO2/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Explain various energy resources and their role in power generation. 2. Demonstrate knowledge of working principles, layouts, and equipment of conventional power plants. 3. Evaluate the feasibility and challenges of renewable energy-based power generation. 4. Analyze economics, load forecasting, and tariff structures in power generation systems. 5. Apply knowledge of modern technologies like distributed generation, cogeneration, and smart grids for sustainable energy solutions.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	B.R. Gupta, Generation of Electrical Energy, S. Chand	2018
2.	M.M. El- Wakil, Power Plant Technology, McGraw-Hill	2016
3.	P.K. Nag, Power Plant Engineering, Tata McGraw-Hill	2017
4.	S.N. Singh, Electric Power Generation, Transmission, and Distribution, PHI	2014
5.	G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers	2011
6.	IEEE/IEC Standards on Renewable Energy and Power Generation	Latest

Course Code: BEE-P 615
Course Name: Digital Control System

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Control System, Mathematics, Signal & Systems
Objectives:	1. Discrete Representation of Continuous Systems 2. Discrete System Analysis 3. Stability of Discrete Time System 4. State Space Approach for discrete time systems 5. Design of Digital Control System
Course Coordinator	Mr. Yogesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Discrete Representation of Continuous Systems	Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modeling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.	08	PO1/ PO6/PO7/PO8/PO10/PO12	PSO1
UNIT-2	Module-II Discrete System Analysis	Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.	08	PO1/ PO2/PO3/PO4/PO6/PO7/PO8/PO10/PO12	PSO1
UNIT-3	Module-III Stability of Discrete Time System	Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.	08	PO1/ PO2/PO3/PO4/PO6/PO7/PO8/PO10/PO12	PSO1/PSO3
UNIT-4	Module-IV State Space Approach for discrete time systems	State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Re-constructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.	08	PO1/ PO2/PO3/PO4/PO6/PO7/PO8/PO10/PO12	PSO1/ PSO3
UNIT-5	Module-V Design of	Design of Discrete PID Controller, Design of discrete state feedback	08	PO1/ PO2/PO3/P	PSO1/ PSO3

	Digital Control System	controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.		O4/PO6/P O7/PO8/P O10/PO12	
Total No. of Hours			**40**		

Course Outcomes:	1. Explain the Basics of Digital Control Systems, Discrete representation of continuous systems, Sample and hold circuit. 2. Extend the Stability analysis by Jury test. Stability analysis using bilinear transformation. 3. Illustrate the Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent. Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. 4. Apply the Mapping from s-plane to z plane, Time response of discrete time system. 5. To solve the discrete time systems, State space models of discrete systems, State space analysis, Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability. 6. To analyze Design of digital control system with dead beat response. Practical issues with dead beat response design. Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs.	1995
2.	M. Gopal, “Digital Control Engineering”, Wiley Eastern.	1988
3.	G.F. Franklin, J.D. Powell and M.L. Workman, “Digital Control of Dynamic Systems”, Addison- Wesley.	1998
4.	B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston.	1980

Course Code: BEE-P 616
Course Name: Fundamentals of Drone Technology

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basics of Electrical Engineering, Control Systems, Electronics, and Communication Systems.
Objectives:	1. To provide foundational knowledge of Unmanned Aerial Vehicles (UAVs) and their applications. 2. To develop understanding of drone subsystems such as propulsion, sensors, power supply, and communication. 3. To familiarize students with navigation, control, and flight dynamics of drones. 4. To introduce drone regulations, airworthiness, and safety practices. 5. To prepare students for industry readiness in drone design, operation, and integration with emerging technologies like AI and IoT.
Course Coordinator	Dr. Brijesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten(10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction to Drone Technology	History and evolution of UAVs, Classification of drones (fixed-wing, rotary-wing, hybrid), Drone architecture and major components, Basic principles of flight: lift, thrust, drag, weight, Overview of applications: agriculture, surveillance, delivery, mapping	08	PO1/PO6/PO7	PSO1
UNIT-2	Module-II Drone Components and Propulsion Systems	Drone frames, motors, propellers, and ESCs, Power systems: batteries, fuel cells, hybrid sources, Payload systems: cameras, sprayers, delivery modules, Communication systems: RF, GPS, telemetry, Introduction to ground control stations	08	PO1/PO2/PO4	PSO2
UNIT-3	Module-III Navigation, Control and Sensors	Drone kinematics and dynamics, Flight control systems: open loop, closed loop, PID controllers, Sensors: gyroscope, accelerometer, magnetometer, barometer, GPS, Obstacle detection: ultrasonic, LiDAR, and vision-based sensors, Autonomous navigation and waypoint planning	08	PO2/PO4/PO10/PO12	PSO1/PSO3
UNIT-4	Module-IV Regulations, Safety and Maintenance	Drone regulations: DGCA (India), FAA (USA), ICAO guidelines, UAV classifications by weight and permissible operations, Airworthiness, certification, and licensing	08	PO6/PO7/PO8/PO11	PSO2/PSO3

		requirements, Safety protocols and risk assessment, Maintenance, troubleshooting, and reliability improvement			
UNIT-5	Module-V Emerging Trends and Applications	Drones in agriculture, healthcare, disaster management, and defense, Drone swarms and cooperative missions, Integration with IoT, AI, and Big Data, Future of drone technology: urban air mobility, passenger drones, Ethical and social implications of drone deployment	08	PO6/PO7/PO8/PO12	PSO1/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Explain the fundamental principles, types, and applications of drones. 2. Identify and analyze various drone subsystems such as propulsion, sensors, and communication. 3. Apply concepts of flight dynamics and control systems to drone operation. 4. Interpret regulatory frameworks, safety requirements, and maintenance practices for UAVs. 5. Evaluate emerging technologies and applications of drones for sustainable and innovative solutions.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Tiwari & Garg, Fundamentals of Drone Technology, BPB Publications	2020
2.	Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment, Wiley	2010
3.	R.E. Fahlstrom, Introduction to UAV Systems, Wiley	2012
4.	DGCA India, Civil Aviation Requirements (CAR) for RPAS	Latest
5.	Kilian & Hajek, Small Unmanned Aircraft: Theory and Practice, AIAA	2014
6.	B. Siciliano & O. Khatib, Springer Handbook of Robotics	2016

Course Code: BEE-O 617
Course Name: Fundamentals of AI

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic knowledge of Mathematics, Algorithms, Data Structures, and Programming.
Objectives:	1. To introduce students to the foundations and history of Artificial Intelligence. 2. To develop problem-solving abilities using search strategies and knowledge representation. 3. To provide understanding of reasoning, inference, and learning techniques. 4. To expose students to AI applications in engineering, industry, and daily life. 5. To prepare students for advanced studies, research, and careers in intelligent systems and data-driven technologies.
Course Coordinator	Dr. Brijesh Kumar

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction to AI	Definition, history, and evolution of AI, Foundations and scope of AI, AI applications in engineering, business, healthcare, robotics, and daily life, AI vs Human Intelligence, Future of AI and ethical considerations	08	PO1/PO6/PO7	PSO1
UNIT-2	Module-II Problem Solving and Search Techniques	Problem formulation and state space representation, Search strategies: uninformed (BFS, DFS) and informed (A*, Best-first), Heuristic search and optimization, Constraint satisfaction problems (CSPs), Applications of search techniques in real-world problems	08	PO1/PO2/PO4	PSO2
UNIT-3	Module-III Knowledge Representation and Reasoning	Propositional and predicate logic, Semantic networks and frames, Rule-based systems and production systems, Forward and backward reasoning, Uncertainty handling: probability, Bayes theorem, fuzzy logic (overview)	08	PO2/PO4/PO10	PSO1/PSO3
UNIT-4	Module-IV Learning in AI	Introduction to Machine Learning, Supervised, unsupervised, and reinforcement learning (overview), Decision trees and neural networks (basics), Expert systems and case-based reasoning, Applications of ML in classification, prediction, and control systems	08	PO2/PO4/PO6/PO10	PSO2/PSO3
UNIT-5	Module-V Applications	AI in natural language processing, speech, and vision, AI in robotics and	08	PO6/PO7/PO8/PO12	PSO1/PSO3

	and Emerging Trends in AI	autonomous systems, Smart systems: IoT + AI (AIoT), AI ethics, bias, and societal impact, Emerging trends: deep learning, generative AI, explainable AI (XAI)			
Total No. of Hours			**40**		

Course Outcomes:	1. Explain the foundations, scope, and applications of Artificial Intelligence. 2. Apply search techniques and problem-solving methods in AI. 3. Represent knowledge using logical and rule-based systems, and perform reasoning. 4. Demonstrate the use of learning methods such as supervised and unsupervised learning. 5. Analyze real-world applications of AI and evaluate ethical and societal implications.

Suggested Books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson	2021
2.	Elaine Rich & Kevin Knight, Artificial Intelligence, McGraw-Hill	2017
3.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI	2009
4.	Nils J. Nilsson, Principles of Artificial Intelligence, Springer	2014
5.	Deepak Khemani, Artificial Intelligence, McGraw-Hill Education	2013

Course Code: BEE-O 618
Course Name: Soft Computing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic knowledge of Mathematics, Algorithms, and Fundamentals of Artificial Intelligence.
Objectives:	1. To introduce students to the fundamental concepts and techniques of soft computing. 2. To develop understanding of fuzzy systems, fuzzy logic, and their real-world applications. 3. To train students in applying evolutionary computation, neural networks, and hybrid approaches for problem-solving. 4. To foster analytical and programming skills for designing soft computing-based solutions. 5. To prepare students for advanced studies, research, and industrial applications in intelligent systems and decision-making.
Course Coordinator	Mr. Aviral Awasthi

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-I Introduction to Soft Computing	Definition, scope, and importance of soft computing, Difference between hard computing and soft computing, Applications in engineering and real-world problems, Overview of soft computing techniques: Neural Networks & Genetic Algorithms.	08	PO1/PO6/PO7	PSO1
UNIT-2	Module-II Fuzzy Sets and Fuzzy Logic	Fuzzy Logic, Crisp sets vs fuzzy sets, Fuzzy set operations and properties, Membership functions and fuzzification, Fuzzy rules, fuzzy reasoning, and fuzzy inference systems, Defuzzification Methods	08	PO1/PO2/PO4	PSO2
UNIT-3	Module-III Neural Networks	Biological inspiration and artificial neural network, Basic models: Perceptron, Multilayer Perceptron (MLP), Back propagation algorithm, Supervised and Unsupervised learning.	08	PO2/PO4/PO10	PSO1/PSO3
UNIT-4	Module-IV Genetic Algorithms and Optimization	Introduction to evolutionary computation, Genetic operators: selection, crossover, mutation, Fitness function and population evolution, Applications of GA in optimization and search problems, Hybrid approaches: Neuro-fuzzy and GA-fuzzy systems	08	PO2/PO4/PO6/PO10	PSO2/PSO3

UNIT-5	Module-V Applications of Soft Computing	Fuzzy logic controllers in engineering systems, Soft computing in power systems, robotics, and control, Decision support systems using fuzzy and neural networks, Kohnen's self-organizing network and Hopfield network	08	PO6/PO7/PO8/PO12	PSO1/PSO3
Total No. of Hours			**40**		

Course Outcomes:	1. Explain the concepts, techniques, and importance of soft computing. 2. Apply fuzzy logic and fuzzy set theory to develop intelligent systems. 3. Implement basic neural network models for problem-solving. 4. Utilize genetic algorithms for optimization in engineering and real-world applications. 5. Integrate fuzzy, neural, and evolutionary techniques to solve complex problems in control, decision-making, and data analysis.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	S. Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI	2017
2.	Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley	2016
3.	Simon Haykin, Neural Networks and Learning Machines, Pearson	2010
4.	D.E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison Wesley	1989
5.	Jang, Sun, & Mizutani, Neuro-Fuzzy and Soft Computing, Pearson	1997
6.	Karray & Silva, Soft Computing and Intelligent Systems Design, Addison Wesley	2004

POWER SYSTEM-II LABORATORY

BEE-C 661

MM: 50
Time: 2 Hr
L T P
0 0 2

Sessional: 15
ESE: 35
Credit: 1

LIST OF EXPERIMENTS

Note: Experiments on software platforms preferably on PSCAD/MATLAB/Sci lab or any software.

1. To locate the faulted point on the cable using cable fault locator.
2. To study single line to ground fault as practical application in transmissions lines.
3. To study three phase fault as practical application in transmission lines.
4. To develop a computer program for Y-bus.
5. To develop a computer program for Z-bus.
6. To develop a computer program for Gauss-Seidel method.
7. To develop a computer program for Newton-Raphson method.
8. To develop a computer program to analyze L-G faults.
9. To develop a program for L-L fault in the power transmission line.
10. To develop a program for L-L-L fault in the power transmission line.

Note: Below experiments are to be performed using Virtual Labs (An initiative of the Ministry of Education, Government of India). (5 Experiments are Compulsory)

1. To study the Synchronization of alternator with infinite bus bar.
2. To determine the direct axis reactance (X_d) and quadrature axis reactance (X_q) of synchronous machine.
3. To determine positive sequence, negative sequence and zero sequence reactances of an alternator.
4. To measure the dielectric Strength of transformer oil.
5. To Study the effect of different shape of electrodes on dielectric (air) breakdown.
6. To Study the gas actuated Buchholz relay for oil filled transformer.
7. To Study the over-current relay and the effect of PSM and TSM.
8. To determine the sub-transient (x_d''), transient (x_d') and steady state reactance (x_d) of a synchronous machine.
9. To Study the Ferranti Effect of a transmission line/cable.
10. To study the differential Protection of a three phase delta-delta connected transformer.
11. To study the Protection of a three phase Induction Motor using Numerical Relay.

COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES LABORATORY
BEE-C 662

MM: 50
Time: 2 Hr
L T P
0 0 2

Sessional: 15
ESE: 35
Credit: 1

LIST OF EXPERIMENTS

1. To develop a computer program to design single phase core type transformer.
2. To develop a computer program to design single phase shell type transformer.
3. To develop a computer program to design three phase core type transformer.
4. To develop a computer program to design three phase shell type transformer.
5. To develop a computer program to design three phase squirrel cage Induction motor.
6. To develop a computer program to design three phase slip ring Induction motor.
7. To develop a computer program to design a D. C. series motor.
8. To develop a computer program to design a synchronous machine.
9. To develop a computer program to design a DC shunt motor.
10. To develop a computer program to design a DC generator.

Note: 5 Experiments are Compulsory to be performed using Virtual Labs (An initiative of the Ministry of Education, Government of India).

MICROPROCESSORS AND INTERFACING LABORATORY
BET-C 666

MM: 50
Time: 2 Hr
L T P
0 0 2

Sessional: 15
ESE: 35
Credit: 1

LIST OF EXPERIMENTS

1. Study of 8085/8086 microprocessor trainer kit and its instruction set.
2. Write and execute ALP for basic arithmetic operations (add, sub, mul, div).
3. Perform code conversion: BCD ↔ Binary, Hex ↔ Decimal using ALP.
4. Implement sorting (asc/desc) and searching in an array using ALP.
5. Write ALP for string manipulation: reverse, count, and palindrome check.
6. Interface 8255 PPI to control LEDs, seven-segment display, and switches.
7. Interface ADC/DAC with microprocessor for A/D and D/A conversion.
8. Interface and control a stepper motor for direction and speed using microprocessor.
9. Interface 8253/8254 PIT to generate time delays and square waveforms.
10. Interface 8259 PIC to demonstrate interrupt handling with microprocessor.