DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

OPEN ELECTIVE-II LIST

AS PER

AICTE MODEL CURRICULUM & NEP2020

[Effective from the Session: 2025-26]

Note:

1. The Student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the degree programme.
2. * It is mandatory that for these subjects (BOE076, BOE079) only Trained Faculty (who had done the FDP for these courses) will teach the courses.

OPEN ELECTIVE-II LIST 2025-26

B.Tech. VII Semester (2025-26)

OPEN ELECTIVE-II

BOE070	PROJECT MANAGEMENT
BOE071	FILTER DESIGN
BOE072	BIOECONOMICS
BOE073	MACHINE LEARNING
BOE074	RENEWABLE ENERGY RESOURCES
BOE075	OPERATIONS RESEARCH
BOE076	VISION FOR HUMANE SOCIETY
BOE077	DESIGN THINKING
BOE078	SOIL AND WATER CONSERVATION ENGINEERING
BOE079	INTRODUCTION TO WOMEN'S AND GENDER STUDIES
BOE080	SMART MANUFACTURING FOR INDUSTRY 4.0

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BOE070	PROJECT MANAGEMENT	3L 0T 0P	Credits: 3

Course Objective: This course aims to equip students with essential knowledge and skills in project management, covering the complete project lifecycle—from initiation and planning to execution, control, and closure. It emphasizes practical tools like PERT/CPM, quality management, resource planning, and project finance for successful project implementation across diverse domains.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Discuss complete structure of project management and analyze the scope of project planning.	K2
CO2	Identify different project selection methods.	K2
CO3	Explain the importance of procurement and its techniques.	K2
CO4	Define the guidelines required for project control and its controlling techniques.	K2
CO5	Outline the basic idea of projects and its initial management.	K2

Unit	Content	Hours
I	**Introduction:** Characteristics of a project types of projects, Project Management Body of Knowledge (PMBOK), role of project manager and his qualities, project organization and benefits, idea generation, needs of society, import substitution, project lifecycle, project charter, project sponsor. **Project Planning:** Customer needs, stake holder concept, project scope, feasibility study and report, baseline plan, SWOT analysis, project organization structure and hierarchy, project teams, formation, attitude and aptitude.	8
II	**Structure:** Project selection methods, breakeven analysis, DCF methods, project implementation, estimation, cost, price, value, scheduling, bar charts, network diagrams, PERT and CPM, schedule crashing, simple introduction to risk management, probability in project management, decision trees.	8
III	**Procurement:** Vendor selection methods, JIT, supply chains, quality, quality circles, quality control and quality assurance, cause and effect analysis, ISO and concepts of total quality management and six sigma, resource planning and allocation, availability and constraints of resources, resource leveling and crashing.	8

IV	**Project Control:** Project scope, project change request, and control of schedule, resources, cost and quality, project communications, channels, means, meetings, project reports, project audits Project evaluation, project close-out reports, guidelines, audit reports, maintenance and shutdown projects, plant turn- around and brief introduction to replacement analysis	8
V	**Projects:** Contour maps, sitemaps, plant layout, suitability of project site, preparation of site, selection and leasing of construction equipment special considerations in selection and location of projects, safety, health, human and environment al factors, project finance, international projects, joint ventures, collaborations, impact of culture, implementation, and handing over of projects.	8

Text Books:

1. Kamaraj Ramakrishna, "Essentials of Project Management", PHI Learning, New Delhi, 2010.
2. Prasanna Chandra, "Projects – Planning, analysis, selection, implementation and review", Tata McGraw-Hill, New Delhi, 2010.
3. Chitkara, "Construction Project Management", Tata McGraw- Hill, New Delhi.
4. Harold Kerzner, "Project Management", Wiley, New York.
5. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
6. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

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BOE071	FILTER DESIGN	3L 0T 0P	3 Credits

Course Objective: The objective of the course *Filter Design* is to equip students with the theoretical knowledge and practical skills required to analyze, design, and implement various types of analog and digital filters. The course emphasizes filter approximation techniques, frequency response shaping, pole-zero analysis, and the application of filters in signal processing, with a focus on Butterworth, Chebyshev, Inverse Chebyshev, and Cauer designs, as well as switched capacitor filters used in modern electronic systems.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Choose an appropriate transform for the given signal.	K2
CO2	Choose appropriate decimation and interpolation factors for high performance filters.	K2
CO3	Model and design an AR system.	K3
CO4	Implement filter algorithms on a given DSP processor platform.	K3
CO5	Design and analyze Chebyshev, Inverse Chebyshev, and Cauer filters based on frequency specifications using rational functions and pole-zero locations.	K4

Unit	Content	Hours
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling. Operational Amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8

IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, from specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.	8

Text Books:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, “Analog Filter Design”, 2nd Indian Edition, Oxford University Press.

Reference Books:

1. J. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Second edition, Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, “Continuous-Time Active Filter Design”,CRC Press.

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BOE072	BIOECONOMICS	3L 0T 0P	3 Credits

Course Objective: This course aims to provide foundational knowledge of analog filter design and operational amplifier applications, along with an interdisciplinary overview of the bioeconomy. It emphasizes sustainable use of biobased resources, environmental economics, and innovation for sustainable development.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand basic concept of Bioeconomics, challenges, opportunities & regulations.	K2
CO2	Understand development and innovation in terms of bioeconomy towards sustainable development	K2
CO3	Understand Inter- and transdisciplinary in bioeconomy & research approaches.	K2
CO4	Explain biobased resources ,value chain, innovative use of biomass and biological knowledge to provide food, feed, industrial products	K2
CO5	Apply sustainable and innovative bio-based solutions for food, energy, and industrial needs while understanding the broader impact of bioeconomy in societal and policy contexts.	K3

Unit	Content	Hours
I	Definition and scope of bioeconomy, Historical evolution and development, Core principles and interdisciplinary nature, Role of biological resources in the economy, Importance of bioeconomy in sustainability, Influence on public, scientific, and political discourse	8
II	Economic Growth, Development, and Innovation in terms of bioeconomy, Environmental Economics and the Role of Government, Modelling and Tools Supporting the Transition to a Bioeconomy , Role of biobased Economy in sustainable development.	8
III	Inter and transdisciplinary in Bioeconomy & research approaches, primary production, processing of biobased resources, Markets, Sustainability Management and Entrepreneurship in biobased products.	8
IV	Biobased Resources and Value Chains, Processing of Biobased Resources, Markets, Sustainability Management and Entrepreneurship opportunity in biobased product. Food Security and Healthy Nutrition in the Context of the Bioeconomy, Use of Biomass for the Production of Fuel and	8

	Chemicals, The importance of Biotechnology for the Bioeconomy.	
V	Sustainable and innovative use of biomass and biological knowledge to provide food, feed, industrial products, bioenergy and ecological services, importance of bioeconomy related concepts in public, scientific, and political discourse, Dynamic Management of Fossil Fuel, Biofuel.	8

Text Books:

1. Principles of Bioeconomics by I. Sundar, Vedams eBooks (P) Ltd. New Delhi, India
2. Bioeconomy: Shaping the Transition to a Sustainable, Biobased Economy by Iris Lewandowski, Springer.
3. Sociobiology and Bioeconomics by Koslowski, Peter.
4. Modeling, Dynamics, Optimization and Bioeconomics I, by Pinto, Alberto Adrego, Zilberman, David, Springer.

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BOE073	MACHINE LEARNING	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to provide a comprehensive understanding of core machine learning concepts, algorithms, and models, enabling students to design, implement, and evaluate learning systems across various paradigms including neural networks, Bayesian methods, and reinforcement learning.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand and analyze fundamental concepts of machine learning, including the design of learning systems and the role of hypothesis space and inductive bias.	K2
CO2	Apply and evaluate concept learning algorithms such as Find-S, Candidate Elimination, and decision tree learning, while addressing related issues and biases.	K4
CO3	Design and implement artificial neural networks using perceptrons, Adaline, and backpropagation, and assess their convergence and generalization capabilities	K3
CO4	Utilize probabilistic models including Bayesian learning, Naïve Bayes classifiers, belief networks, and EM algorithm for accurate hypothesis evaluation and prediction.	K3
CO5	Analyze and implement advanced learning paradigms such as instance-based learning, genetic algorithms, first-order rule learning, and reinforcement learning including Q-learning.	K4

Unit	Content	Hours
I	INTRODUCTION – Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias.	8
II	DECISION TREE LEARNING - Decision tree learning algorithm Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of backpropagation rule Backpropagation Algorithm Convergence, Generalization.	8
III	Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes	8

	Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.	
IV	Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning; INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.	8
V	Genetic Algorithms: an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules- sequential covering algorithms-General to specific beam search-FOIL; REINFORCEMENT LEARNING- The Learning Task, Q learning.	8

Text Books:

1. Tom M. Mitchell,—Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin,—Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer- Verlag.

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BOE074	RENEWABLE ENERGY RESOURCES	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to provide a comprehensive understanding of core machine learning concepts, algorithms, and models, enabling students to design, implement, and evaluate learning systems across various paradigms including neural networks, Bayesian methods, and reinforcement learning.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand the classification, availability, and comparative merits and demerits of various non-conventional energy resources.	K2
CO2	Explain the working principles, construction, and limitations of solar photovoltaic and solar thermal energy systems.	K2
CO3	Describe the principles and performance of geothermal, MHD, fuel cells, thermoelectric, and thermionic energy conversion systems.	K2
CO4	Understand wind, biomass, ocean thermal, wave, and tidal energy technologies in terms of site selection, working, and efficiency.	K2
CO5	Assess the role of waste recycling and alternative energy systems in achieving sustainable energy solutions.	K2

Unit	Content	Hours
I	Introduction: Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.	8
II	Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	8
III	Geothermal Energy: Resources of geothermal energy, thermodynamics of geo- thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Cells: Principle of working of various types of fuel cells and their working, performance and limitations.	8

IV	Thermo-electrical and thermionic Conversions: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.	8
V	Bio-mass: Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.	8

Text Books:

1. Raja et. al, "Introduction to Non-Conventional Energy Resources" SciTech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.
4. D. S. Chauhan, "Non-conventional Energy Resources" New Age International.
5. C. S. Solanki, "Renewable Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.
7. Godfrey Boyle, "Renewable Energy Power for A Sustainable Future", Oxford University Press.

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BOE075	OPERATIONS RESEARCH	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to provide a comprehensive understanding of core machine learning concepts, algorithms, and models, enabling students to design, implement, and evaluate learning systems across various paradigms including neural networks, Bayesian methods, and reinforcement learning.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand the scope, phases, and modeling techniques of Operations Research and apply linear programming methods, including simplex and dual simplex, to solve optimization problems.	K2
CO2	Formulate and solve transportation and assignment problems using appropriate mathematical models and algorithms.	K2
CO3	Apply network techniques like shortest path, minimum spanning tree, max-flow, and CPM/PERT for efficient project and resource management.	K3
CO4	Analyze decision-making problems using game theory and queuing models, and evaluate their practical applications in operations systems.	K4
CO5	Apply inventory and replacement models for effective control of stock and maintenance of deteriorating or failing equipment.	K3

Unit	Content	Hours
I	Introduction: Definition and scope of operations research (OR), OR model, solving the OR model, art of modelling, phases of OR study. Linear Programming: Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.	8
II	Transportation Problems: Types of transportation problems, mathematical models, transportation algorithms, Assignment: Allocation and assignment problems and models, processing of job through machines.	8
III	Network Techniques: Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Project Management: Phases of project management, guidelines for network construction, CPM and PERT	8

IV	Theory of Games: Rectangular games, Minimax theorem, graphical solution of 2x n or mx2 games, game with mixed strategies, reduction to linear programming model. Quality Systems: Elements of Queuing model, generalized Poisson queing model, single server models.	8
V	Inventory Control: Models of inventory, operation of inventory system, quantity discount. Replacement: Replacement models: Equipment's that deteriorate with time, equipment's that fail with time.	8

Text Books:

1. Wayne L. Winston, "Operations Research" Thomson Learning, 2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education, 2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V. K. Khanna, "Total Quality Management" New Age International, 2008.

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BOE076	VISION FOR HUMANE SOCIETY	3L 0T 0P	3 Credits

Pre-requisites- for this subject only those faculties will teach these courses who had done the FDP for these courses.

Course Objective: The objective of this course is to enable students to understand the significance and forms of human relationships, develop a conceptual understanding of an undivided society and universal human order, and gain insights into the process of transitioning from the current societal state to a harmonious and holistic social structure.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand the foundational human aspirations, the role of relationships, and the need for an undivided society and universal human order.	K2
CO2	Recognize and Understand human relationships, understand the expression and fulfillment of feelings, and comprehend the role of justice in shaping human conduct, culture, and civilization.	K2
CO3	Understand the expansion of justice from family to world family order and the conceptual framework for a universal human order.	K2
CO4	Understand the role of education, health, production, exchange, and justice as essential programs for ensuring an undivided society and universal human order.	K2
CO5	Understand the scope and steps of establishing a universal human order through human tradition and identify their role in the transition from the current state.	K2

Unit	Content	Hours
I	Introduction to the course: Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Human- relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order, an appraisal of the Current State, Appraisal of Efforts in this Direction in Human History.	8
II	Understanding Human-Human Relationship & its fulfilment: Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings, Types of relationship and	8

	their purpose, mutual evaluation in relationship, Meaning of justice in relationship, Justice leading to culture, civilization and Human Conduct.	
III	Justice from family to world family order: Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order, Universal Human Order as continuity and expanse of order in living: from family order to world family order, a conceptual framework for universal human order.	8
IV	Program for Ensuring Undivided Society and Universal Human Order: Education –Sanskar, Health –Sanyam, Production-work, Exchange – storage, Justice-preservation.	8
V	Human Tradition: Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order), Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.	8

Text Books:

1. A Foundation Course in Human Values and Profession Ethics (Text Book and Teachers' Manual), R. R. Gaur, R. Asthana, G. P. Bagaria (2010), Excel Books, New Delhi.
2. Avartansheel Arthshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
3. An Appeal by the Dalai Lama to the World: Ethics Are More Important Than Religion, Dalai Lama XIV, 2015.
4. Economy of Permanence – (a quest for social order based on non-violence), J. C. Kumarappa (2010), Sarva-Seva-Sangh-Prakashan, Varansi, India.
5. Energy and Equity, Ivan Illich (1974), The Trinity Press, Worcester & Harper Collins, USA.
6. Human Society, Kingsley Davis, 1949.
7. Hind Swaraj or, Indian home rule Mohandas K. Gandhi, 1909.
8. Integral Humanism, Deendayal Upadhyaya, 1965.
9. Lohiya Ke Vichar, Lok Bharti , Rammanohar Lohiya, 2008.
10. Manav Vyavahar Darshan, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
11. Manaviya Sanvidhan, A. Nagraj, Divya Path Sansthan, Amarkantak, India
12. Samadhanatmak Bhautikvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India
13. Small Is Beautiful: A Study of Economics as if People Mattered, E. F. Schumacher,1973, Blond & Briggs, UK.
14. Slow is Beautiful, Cecile Andrews

(http://www.newsociety.com/Books/S/Slow-is- Beautiful)
15. Sociology Themes and Perspectives, Harper Collins; EIGHT edition (2014), Martin Holborn and Peter Langley, 1980.
16. Samagra kranti: Jaya Prakash Narayan's philosophy of social change, Siddharth Publications Renu Sinha, 1996.
17. Science & Humanism – towards a unified worldview, P. L. Dhar & R. R. Gaur (1990), Commonwealth Publishers, New Delhi
18. Vyavaharvadi Samajshastra, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
19. Vyavahatmak Janvad, A. Nagraj, Divya Path Sansthan, Amarkantak, India.
20. The Communist Manifesto, Karl Marx, 1848.
21. Toward a True Kinship of Faiths: How the World's Religions Can Come Together Dalai Lama XIV, 2011

Reference Videos:

1. Kin school (30 minutes) 2. Technology (Solar City etc.)
2. Natural Farming
3. Economics of Happiness (1h 8m).

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BOE077	DESIGN THINKING	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Develop a strong understanding of the design process and apply it in a variety of business settings.	K6
CO2	Analyze self, culture, teamwork to work in a multidisciplinary environment and exhibit empathetic behavior.	K4
CO3	Formulate specific problem statements of real time issues and generate innovative ideas using design tools.	K6
CO4	Apply critical thinking skills in order to arrive at the root cause from a set of likely causes.	K3
CO5	Demonstrate an enhanced ability to apply design thinking skills for evaluation of claims and arguments.	K6

Unit	Content	Hours
I	Introduction to design thinking, traditional problem solving versus design thinking, history of design thinking, wicked problems. Innovation and creativity, the role of innovation and creativity in organizations, creativity in teams and their environments, design mindset. Introduction to elements and principles of design, 13 Musical Notes for Design Mindset, Examples of Great Design, Design Approaches across the world.	8
II	Understanding humans as a combination of I (self) and body, basic physical needs up to actualization, prosperity, the gap between desires and actualization. Understanding culture in family society, institution, startup, socialization process. Ethical behavior: effects on self, society, understanding core values and feelings, negative sentiments and how to overcome them, definite human conduct: universal human goal, developing human consciousness in values, policy, and character. Understand stakeholders, techniques to empathize, identify key user problems. Empathy tools- Interviews, empathy maps, emotional mapping, immersion and observations, customer journey maps, and brainstorming, Classifying insights after Observations, Classifying	8

	Stakeholders, Do's & Don'ts for Brainstorming, Individual activity- 'Moccasin walk'	
III	Defining the problem statement, creating personas, Point of View (POV) statements. Research- identifying drivers, information gathering, target groups, samples, and feedbacks. Idea Generation-basic design directions, Themes of Thinking, inspirations and references, brainstorming, inclusion, sketching and presenting ideas, idea evaluation, double diamond approach, analyze – four W's, 5 why's, "How Might We", Defining the problem using Ice-Cream Sticks, Metaphor & Random Association Technique, Mind-Map, ideation activity games - six thinking hats, million-dollar idea, introduction to visual collaboration and brainstorming tools - Mural, JamBoard.	8
IV	Fundamental concepts of critical thinking, the difference between critical and ordinary thinking, characteristics of critical thinkers, critical thinking skills- linking ideas, structuring arguments, recognizing incongruences, five pillars of critical thinking, argumentation versus rhetoric, cognitive bias, tribalism, and politics. Case study on applying critical thinking on different scenarios.	8
V	The argument, claim, and statement, identifying premises and conclusion, truth and logic conditions, valid/invalid arguments, strong/weak arguments, deductive argument, argument diagrams, logical reasoning, scientific reasoning, logical fallacies, propositional logic, probability, and judgment, obstacles to critical thinking. Group activity/role plays on evaluating arguments.	8

Text Books:

1. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, 2013, John Wiley and Sons Inc, New Jersey
2. BP Banerjee, Foundations of Ethics and Management, 2005, Excel Books
3. Gavin Ambrose and Paul Harris, Basics Design 08: Design Thinking, 2010, AVA Publishing SA
4. Roger L. Martin, Design of Business: Why Design Thinking is the Next Competitive Advantage, 2009, Harvard Business Press, Boston MA.

OPEN ELECTIVE-II LIST 2025-26

BOE078	SOIL AND WATER CONSERVATION ENGINEERING	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to familiarize students with design thinking process as a tool for breakthrough innovation. It aims to equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand the definition, scope, causes, and mechanisms of soil erosion, as well as the practices for controlling wind erosion and vegetation management techniques.	K2
CO2	Identify different types of soil erosion caused by water, their effects on sediment transport and deposition, and describe various methods for controlling erosion and managing agricultural land.	K2
CO3	Gain knowledge of biological methods for soil erosion control, as well as techniques for managing soil quality, water conservation, and reclamation of salt-affected soils.	K1
CO4	Understand water losses due to filtration, seepage, and evaporation, and explore the pollution of water quality from agricultural practices and the process of self-purification.	K2
CO5	Understand the need for planned utilization of water resources, the economics of water management, and effective strategies for managing flood-prone areas and reducing flood impacts.	K2

Unit	Content	Hours
I	Definition and scope of soil conservation, cause of soil erosion, Mechanism of erosion, universal soil loss equation, soil erosion due to wind and its control, vegetation management, i.e., strip cropping, stubble mulching and other practices.	8
II	Types of soil erosion due to water- sheet erosion, rill erosion, gully erosion, sediment transport in channels, sediment deposition in reservoirs. Methods of soil erosion control: bounding and terracing on agriculture land for gully control, bench terraces, vegetated water ways, chute spillways, drop inlet spillways, check dams, river training works.	8
III	Biological methods of soil erosion control, grass land management, forest management. Soil quality management, drainage works, reclamation of salt affected soils. Water conservation: water harvesting, rainfall- run off relation, water	8

	storage in ponds, lakes, reservoirs and aquifers, groundwater recharge through wells, check dams and storage works.	
IV	Water losses: filtration, seepage and evaporation losses, pollution/ contamination of water quality due to agricultural practices i.e., fertilizers and pesticides, self purification of surface water, sources of agricultural water pollution, pollutant dispersion in ground water.	8
V	Need of planned utilization of water resources, economics of water resources utilization. Flood plain zones management, modifying the flood, reducing susceptibility to damage, reducing the impact of flooding.	8

Text Books:

1. Alam Singh – Modern Geotechnical Engineering
2. K. R. Arora – Soil Mechanics and foundation Engineering.
3. N. C. Brady – Principles of Soil Sciences
4. B. C. Punmia – Soil Mechanics and Foundation Engineering

OPEN ELECTIVE-II LIST 2025-26

BOE079	INTRODUCTION TO WOMEN'S AND GENDER STUDIES	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to provide students with a comprehensive understanding of the concepts of sex, gender, and patriarchy, explore feminist theories and movements, analyze the socio-economic conditions of women throughout history, examine gender roles and psychological impacts of gender-based trauma, and critically evaluate gender representation in mass media and literature.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Understand how sex, gender, and patriarchy shape societal roles and institutions.	K2
CO2	Understand the rise of feminism and key feminist theories and waves.	K2
CO3	Understand the historical socio-economic conditions of women and the women's rights movement.	K2
CO4	Understand gender roles, psychological differences, and the impact of gender-based trauma.	K2
CO5	Understand how gender is represented in mass media and literature, and the impact of stereotypes.	K2

Unit	Content	Hours
I	Women and Society: Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Private and Public dichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.	8
II	Feminist Theory: Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post Colonial Feminism, Post Modern Feminism. Waves of Feminism.	8
III	Women's Movement: The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920,Historical Developments of Social Reform Movements in India , Women's groups and organizations, Women's Movement Movements for Uniform Civil code and ShahBano case, Dalit women and the question of double marginality.	8

IV	Gender Roles and Psychology of Sex: Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape , Taboo , Childhood Sexual Abuse , Domestic Violence , Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.	8
V	Gender and Representation: Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.	8

Text Books:

1. Basab iChakrabarti, Women's Studies: Various Aspects. UrbiPrakashani2014
2. Arvind Narrain. Queer: Despised Sexuality Law and Social Change. Book for Change, 2005
3. Chandra Talpade Mohanty, Feminism without Borders: Decolonizing Theory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India. Oxford University Press, 2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press, Sage, New Delhi, 1998.

OPEN ELECTIVE-II LIST 2025-26

BOE080	SMART MANUFACTURING FOR INDUSTRY 4.0	3L 0T 0P	3 Credits

Course Objective: The objective of this course is to introduce students to Industry 4.0 concepts for smart manufacturing, covering the use of hardware, communication protocols, and IoT layers. It also aims to explore cloud computing platforms and machine learning applications to optimize and enhance smart factory operations.

After completion of the course student will be able to:

COs	CO Statement	BL
CO1	Introduce concept of Industry 4.0 for Smart Manufacturing.	K2
CO2	Understand use various hardware used in Smart Manufacturing.	K2
CO3	Understand need of various communication protocols. hardware and software, IoT Layers and their relative importance.	K2
CO4	Understand could-computing IoT platform for Smart Manufacturing.	K2
CO5	Understand machine learning to make smart factories.	K2

Unit	Content	Hours
I	**Industry 4.0:** Concept, Globalization and emerging issues, The Fourth Revolution, LEAN manufacturing, Smart and connected business perspectives, Smart factories**.**	8
II	**Automation:** Programable Logic Controller (PLC) and its Programming software, Communication of different devices with PLC, Sensor, Smart Sensor, HMI design, Cyber Physical System – key components, ISA-95 architecture, CPS-5C architecture, Concept of Digit Twin	8
III	**Communication:** Protocols-MQTT, OPC UA, EtherNet/IP, Profinet, EtherCAT, etc; MQTT- History, MQTT broker, Message types, Quality of Service (QoS), Application; OPC UA-History, Specification, Client, Server, Programming with -Free and open-source software, Propriety software; Augmented Reality	8
IV	**IoT Platform:** Data Modelling, IoT Platforms-Thing, basic functionalities, Abstract definition of Thing, Networks, etc; IoT Gateway, Machine Interfaces-Cloud-based Mosquitto brokers, Programming with – Free and open-source software, Propriety software	8

V	**Machine Learning Foundation:** Learning algorithms - Supervised, Unsupervised, Self learning, Feature learning, etc. Models Artificial Neural Networks, Decision trees, Regression analysis, Genetic algorithms, etc.; Programming with – Free and open-source software, Propriety software	8

Text Books:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0 – An Empirical Analysis of Technologies and Application in Production Logistics", Spinger Gabler, 2015
2. Alasdair Gilchrist, "Industry 4.0 – The Industrial Internet of Thigs", Springer Link, 2016
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
4. Michahelles, "Architecting the Internet of Things", ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
5. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Willy Publications.
6. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications
7. W. Botton, "Programmable Logic Controllers", Fourth Edition, Elsevier, 2006