CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
An Autonomous Institute I Affiliated to Osmania University
Kokapet Village, Gandipet Mandal, Hyderabad, Telangana-500075, www.cbit.ac.in

COMMITTED TO RESEARCH, INNOVATION AND EDUCATION 45 years

List and Syllabus of Open Electives for UG: R22 and R22(A) Regulations

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Affiliated to OU, Approved by AICTE, Accredited by NBA, NAAC (A++)

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2022-23

OPEN ELECTIVES

CHAITANYA BHARATI INSTITUTE OF TECHNOLOGY (A)				
R-22/ R-22 (A) List of Open Electives				
Sl No	**Course Code**	**Course Name**	**Offering Department**	**Page No.**
1.	22MBO01	Principles of Management	SMS	06
2.	22MBO02	Strategic Entrepreneurship	SMS	08
3.	22MBO03	Organizational Behaviour	SMS	10
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6.	22CAO01	Foundations of Artificial Intelligence and machine learning	AIML	17
7.	22CAO02	Ethical Intelligence	AIML	19
8.	22CAO03	Foundations of Deep learning	AIML	21
9.	22CSO01	Introduction to Web Technologies	CSE	24
10.	22CSO02	Introduction to DBMS	CSE	26
11.	22CSO03	Software Testing Methodology	CSE	28
12.	22CSO04	Web programming with JAVA script	CSE	30
13.	22CSO05	Fundamentals of JAVA Programming	CSE	32
14.	22ITO01	Object Oriented Programming Using JAVA	IT	35
15.	22ITO02	Object Oriented Programming using C++	IT	37
16.	22ITO03	Introduction to Cloud Computing	IT	39

44.	22BTO01	Biology For Engineers	Biotech	101
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46.	22BTO03	Bioterrorism And National Security	Biotech	105
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48.	22BTO05	Cognitive Neuroscience	Biotech	109
49.	22CHO01	Fuel Cells and Batteries	Chemical	112
50.	22CHO02	Fundamentals of Nano Science and Nano Technology	Chemical	114
51.	22CHO03	Industrial Pollution Control	Chemical	116
52.	22CHO04	Environmental and Sustainable Development	Chemical	118
53.	22CHO05	Material Science Engineering	Chemical	120
54.	22CHO06	Safety and Hazards Management	Chemical	122
55.	22MEO01	Principles of Design Thinking	Mechanical	125
56.	22MEO02	3D Printing	Mechanical	127
57.	22MEO03	Corporate Organizational Behaviour	Mechanical	129
58.	22MEO04	Introduction to Operations Research	Mechanical	131
59.	22MEO05	Research Methodologies and Innovation	Mechanical	133
60.	22MEO06	Principles of Entrepreneurships and Startups	Mechanical	135
61.	22MEO07	Futuristic Vehicular Technology	Mechanical	137
62.	22MTO01	Fundamentals of Quantum Computing	Maths	140
63.	22MTO02	Optimization Techniques	Maths	142
64.	22MTO03	Biostatistics	Maths	144
65.	22PHO01	History of Science & Technology	Physics	147
66.	22EGO01	Technical Writing Skills	English	150
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Note: Gender Sensitization and Indian Traditional Knowledge should be a mandatory option in any Open Electives.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF SMS

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	22MBO01	PRINCIPLES OF MANAGEMENT
2.	22MBO02	STRATEGIC ENTREPRENEURSHIP
3.	22MBO03	ORGANIZATIONAL BEHAVIOUR
4.	22MBO04	ENGINEERING LEADERSHIP
5.	22MBO05	PRIVATE EQUITY FINANCING

22MBO01

PRINCIPLES OF MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Understand basic fundamentals and insights of management.
2. Understand the nature and purpose of planning.
3. Gain the knowledge about the frame work of organizing.
4. Understand the essence and significance of directing.
5. Recognize the importance of controlling and its outcomes

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COURSE OUTCOMES: After the completion of this course, the student will be able

1. Identify and evaluate the principles of management
2. Demonstrate the ability to have an effective and realistic planning
3. Identify the nature and the type of organization
4. Apply the tools and techniques of directing
5. Explain and evaluate the necessity for controlling and further refinement of an organization.

CO-PO Articulation Matrix

	PO-1	PO2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO10	PO11	PO12
CO-1	-	2	2	1	-	-	-	1	2	1	1	2
CO-2	1	2	1	1	2	1	-	1	2	1	2	1
CO-3	1	1	1	-	-	-	1	1	1	1	-	1
CO-4	1	2	2	2	2	1	1	1	1	1	-	1
CO-5	1	1	-	-	-	1	1	1	1	2	2	2

UNIT – I

Management: Concept of Management, Management- Science or Art, Manager vs Entrepreneur; Evolution of Management- Basic management theories by FW Taylor, Henry Fayol; Managerial Roles and Skills; Types of Business Organizations - Sole Proprietorship, Partnership, Company; How startups are built- An overview. Organization Culture and Environment; Contemporary Management Issues and Challenges.

UNIT - II

Planning: Nature and Purpose of Planning, Planning Process, Types of Plans, Environmental Scanning – SWOT and PEST analysis, Objectives, Managing by Objectives (MBO), Strategies – Types of Strategies, The Strategic Planning Process, The TOWS (Threats, Opportunities, Weaknesses and Strengths) Matrix, Planning Tools and Techniques, Planning Plant Location and Layout. Policies- Types. Decision Making – Types of Decision, Decision Making Process.

UNIT – III

Organizing: Nature and purpose of Organizing, formal and informal organization, Organization Structure – Types, line and staff authority, Departmentation, Span of Control, Centralization and Decentralization, Delegation of Authority. Human resource management- HR Planning, Recruitment selection, Training and Development, Performance Management, Career planning and Management.

UNIT - IV

Directing: Principles and elements of direction, Requirement of Effective Direction – Functions of Direction – Supervisor and his Qualities – Supervisor's Role and Functions – Effective Supervision. Individual and group behaviour, motivation- Theories, leadership- Types and Theories of leadership, effective Communication.

UNIT - V

Controlling: Concept, Process of Controlling, Types of control – Budgetary and non-budgetary control techniques – Requirements for effective control. Use of Computers and IT in Management control, Productivity Problems and Management, Control and Performance, Direct and Preventive control, Reporting.

Text Books:

1. Andrew J. Dubrin, "Essentials of Management", 9th edition, Thomson Southwestern, 2012.
2. Harold Koontz and Heinz Weihrich, "Essentials of management: An International & Leadership Perspective", 9th edition, Tata McGraw-Hill Education, 2012.

Suggested Readings:

1. Charles W.L Hill and Steven L McShane, "Principles of Management", Special Indian Edition, McGraw Hill Education, 2007.
2. Don Hellriegel, Susan E. Jackson and John W. Slocum, "Management- A competency-based approach", 11th edition, Thompson South Western, 2008.
3. Harold Koontz and Cyril O'Donnell "Principles of Management'', Tata McGraw Hill, 2017.
   Stephen P. Robbins, David A.De Cenzo and Mary Coulter, "Fundamentals of management", Prentice Hall of India, 2012.

22MBO02

STRATEGIC ENTREPRENEURSHIP

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Prerequisites: Nil

COURSE OBJECTIVES: This course aims to

1. To understand the importance of generating new ideas through Entrepreneurship and identify the skills for making informed Business Decisions.
2. To provide insights on various branding, promotion, commercialization and financial planning.
3. To help the students develop their abilities for applying various Strategic Management Concepts in solving real time problems in Business.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Use innovative skills to generate ideas for new products and services.
2. Evaluate the feasibility of ideas, and develop a strategy from commercialization.
3. Use technology to select target markets, profile target customers, define venture's mission, and create business plans.
4. Take initial steps to establish a business.
5. Establish brand, setting prices, promoting products, and managing customer relationships.

CO-PO Articulation Matrix

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	2	2	2	1	1	2	1	1	1	1	1
CO-2	1	2	2	2	2	1	1	1	1	1	1	1
CO-3	-	1	1	1	1	1	1	-	1	1	1	1
CO-4	1	-	-	1	1	1	-	1	1	1	1	1
CO-5	-	2	2	2	1	1	1	1	1	1	-	1

UNIT - I

Introduction: Identifying possible rewards and risks of business ownership, risks vs. rewards, risk factors, reasons for business success or failure; challenges with the growth of new business success, life cycle of an entrepreneurial business and challenges at different parts of the life cycle, necessary characteristics of an entrepreneur.

UNIT - II

Identifying the Possibilities: Skills needed to make decisions based on the limited information, essential questions, generate and develop ideas into new products and services for commercialization, steps and factors to turn an idea into revenue.

UNIT - III

Market Analysis: Determining the influencing factors on purchases, effects of branding, promotion types, benefits, promotion channels, importance of small and large marketing segments.

UNIT - IV

Business Finance: Create, Analyze and interpret financial documents, purpose of budget, income statement, balance sheet, understanding and interpretation of information to make business decisions, tools, strategies, and systems to plan and monitor financial resources.

UNIT - V

Planning your Business: Basic necessary requirements to own and operate a business, differences between sole partnership, partnership and corporation; a public and private business; profit and non-profit corporation. Concept of insurance, advertisement strategies, Business and law, Corporate Social Responsibility (CSR), actualization of business and Performance assessment.

Text Books/ Suggested Readings:

1. Greene, C., "Entrepreneurship Ideas in Action", Thomson: South-Western, 2004.
2. Kennedy B. Reed, "Strategic Management", Virginia Tech, 2020.
3. Michaele A. Hitt, R D Ireland, Michael Camp, Dianal Sexton, "Strategic Entrepreneurship – Creating a New Mindset", John Wiley & Sons., 2017
4. Philip A . Wickham, "Strategic Entrepreneurship", 4th Edition, Pearson, 2006.
5. https://vtechworks.lib.vt.edu/bitstream/handle/10919/99282/Strategic Management.pdf?sequence=22&isAllowed=y
6. http://www.chillicothecityschs.oh.schools.bz/userfiles/319/My%20Files/Course%20syllabi%202017-2018/PRCTC/Black/2017-2018%20Strategic%20Entrepreneurship%20Syllabus.pdf?id=4228

22MBO03

ORGANIZATIONAL BEHAVIOUR

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To familiarize the students with the basic understanding of individual behaviour and explore issues of motivation, communication, leadership, power, politics and organizational change.
2. To provide a comprehensive, up-to-date, practical knowledge base that provides an engaging introduction and concepts of organizational behaviour.
3. To orient the students with real life examples that correlate the theory to actual practice from the industry.
4. To enable the students to practically implement the Organizational Behaviour principles and practice in real time situations in their careers and life.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Analyze the behaviour, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
2. Assess the potential effects of organizational-level factors on organizational behaviour.
3. Critically evaluate the potential effects of motivating and leading the individuals in the Organization.
4. Analyze organizational behavioural issues in the context of groups, communication.
5. Develop strategies to deal with power, politics and conflict issues at workplace.

CO-PO Articulation Matrix

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	-	1	1	1	-	1	-	1	1	1	-	1
CO-2	-	1	-	1	1	2	1	1	1	1	-	1
CO-3	1	2	1	2	1	1	-	1	1	1	-	1
CO-4	-	1	1	2	1	-	-	1	2	1	-	1
CO-5	-	2	1	2	-	-	-	2	1	1	-	1

Unit – I

Introduction: Organizational Behaviour – Nature and levels of organizational behaviour – Individuals in organization – Individual differences – Personality and Ability – The Big 5 Model of personality, MBTI – Organizationally relevant personality traits. The nature of perception – characteristics of the perceiver, target and situation – perceptual problems, Attitude, Learning, IQ & EQ.

Unit – II

Organization Structures and Culture: Concept of Organizational Structure– Types of Organizational Structure- Hierarchical organizational structure, Functional organizational structure, Horizontal organizational structure, Divisional organizational structures, Matrix organizational structure, Team-based organizational structure, Network organizational structure. Organizational culture and ethical behaviour – Understanding the dimensions of Culture, what do cultures do? Creating and sustaining culture, creating an ethical culture, managing change.

Unit – III

Motivation and Leadership: Motivation–Concept of Motivation-Theories of Motivation-Maslow's Need-Hierarchy Theory, Herzberg's Motivation-Hygiene Theory, McGregor's Theory X and Theory Y, ERG Theory, Vroom's Expectancy Theory, Equity Theory. Leadership – Concept of Leadership, Leaders vs. Managers-Theories of Leadership- The Great Man theory of Leadership, Trait Theory of Leadership, Contingency Theory of Leadership, Situational Theory of Leadership, Behavioural Theory of Leadership, Presentation on Indian Leaders, Leadership issues in current business environment.

Unit – IV

Group Behaviour: Concept of Groups- Stages of Group Formation- Work groups and teams, Team Building, Team Dynamics, Tuckmann model, Functional and dysfunctional traits of team development. Communication-Interpersonal Communication, organisational communication, roles, frameworks and barriers to effective communication, Transactional Analysis

Unit – V

Power, Politics, Conflict and Negotiations: Power, Politics, Conflict and Negotiations–Sources of individual, functional and divisional Power. Organizational politics. Conflict – causes and consequences – Pondy's model of organizational conflict–conflict resolution strategies.

Text Books:

1. Jennifer George and Gareth Jones "Understanding and Managing Organizational Behavior", Pearson Education Inc., 2021.
2. L.M. Prasad, "Organizational Behaviour", Sultan Chand & Sons; Fifth edition, 2014.
3. K. Aswathappa "Organizational behaviour", Himalaya Publishing House., 2013.

Suggested Reading:

1. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, "Management and Organizational Behaviour", Pearson Education. Inc., Eighteenth Edition, 2018.
2. Richard Pettinger "Organizational Behaviour", Routledge, 2013.
3. John Schermerhorn, Jr. James G. Hunt and Richard N. Osborn "Organizational Behavior", 11th Edition, Wiley India, Edition., 2010.

22MBO04

ENGINEERING LEADERSHIP

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To develop an understanding of the basics of Leadership and Leadership Behaviour.
2. To introduce them the concepts of Adaptive Leadership and Decision making as a Leader.
3. To discuss the importance and components of Change and Cross-Cultures in the Global era.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Apply the knowledge of behaviour and effectiveness of Leadership in real time situations.
2. Understand the dynamics of Situations and Adaptive Leadership and its importance in leading.
3. Appraise the process of Decision Making and Empowerment and Leading in the Global Era.
4. Develop understanding towards dealing with Change, Power and Influence Tactics.
5. Interpret and Improve in cross-Cultural Management and Leadership Skills.

CO-PO Articulation Matrix

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1		1	1	1		1	2	1	1		2
CO-2	1	2	2	2		1		2	2	2	1	2
CO-3	1	1	2	2	1		1	1	1	2		1
CO-4		2	1	2	2	1	1	2	2	2	1	2
CO-5		1	1	1	1	2	1	2	2	2	1	1

Unit - I

Nature and Behaviour of leadership: Definitions of Leadership-Indicators of Leadership Effectiveness-Research Methods for Studying Leadership effectiveness-important Types of Leadership Behaviour-Specific Task Oriented Leader Behaviours- Specific Relations Oriented Leader Behaviours.

Unit - II

The leadership Situation and Adaptive Leadership: Different ways Situations affect Leaders-Stewart Model of Situational Determinants-Other Situational Determinants of Leader Behaviour-Guidelines for Coping with Demands and Constraints-Early Contingency theories of Effective Leader Behaviour-Guidelines for flexible, Adaptive Leadership.

Unit - III

Decision Making and Empowerment by Leaders: Decision making- Participative Leadership-Normative Decision Model-Guidelines for Participative Leadership-Delegation-Guidelines for Delegating-Psychological Empowerment-Empowerment Programs-Benefits of Empowering Leadership and Programs.

Unit - IV

Dealing with Change, Power and Influence Tactics: Types of Change in Teams and Organizations-Change Processes-Reasons for Accepting or Rejecting Change-implementing Change-guidelines for Implementing Change-How Visions influence change-Sources of Power-How Power is gained or lost-consequences of Power-Guidelines for using Power-Influence Tactics and Outcomes-Types of Proactive Influence Tactics-Power and influence Behaviour-Effectiveness of Proactive Tactics-guidelines for using Proactive Influence Tactics.

Unit - V

Developing Cross-Cultural Leadership and Skills of Leadership: Cross-Cultural and Global Leadership-Cultural Values and Leadership-Guidelines for Global Leadership-Gender and Leadership-Leadership Training Programs-Learning from Experience-Developmental Activities-Facilitating Leadership Development-Systems Perspective on Leadership Development.

Text Books:

1. Gary Yukl, William L. Gardner and Nishant Uppal, "Leadership in Organizations", Pearson Education, 9th Edition, 2019.
2. Keow Ngang Tang, "Leadership and Change Management", Springer – First Edition, 2019.
3. Patrick Dawson, Constantin Andriopoulos "Managing Change, Creativity and Innovation", Sage Publications ltd., 2nd Edition, 2014.
4. Lee R Beach, "Leadership and the Art of Change", Sage Publications ltd.,1st Edition, 2005.

Suggested Readings:

1. Ranjana Mittal, Leadership Personal Effectiveness and Team building, Vikas Publictaions, 2015
2. Peter G. Northhouse, Leadership Theory and Practice, Sage Publications, 2011.
3. Barbara Senior, Jocelyne Fleming, Organizational Change, 3e, Pearson publications, 2010
4. Mark Hughes, Managing Change, Universities Press, 2011.
5. Alfranch Nahavandi, The Art and science of Leadership, 7e, Pearson, 2018

22MBO05

PRIVATE EQUITY FINANCING

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation:	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To provide the students with intellectual framework used in the private equity process.
2. To gain knowledge about the Capital Structure of leveraged firms and their Issues.
3. To give insights about the corporate governance, ethics and legal considerations that factor into private equity deals.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Understand the Concept of Private Equity financing and their contribution in Portfolio Construction.
2. Know the perspectives of Investors in Private Equity Funds and the Problems faced by them.
3. Assess the value of highly leveraged private equity firms and their capital structure.
4. Understand the Financial Issues faced by Private Equity Firms and the required Due Diligence.
5. Gain insights about the corporate governance and ethical issues surrounding the use of private equity.

CO-PO Articulation Matrix

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	-	1	1	-	1	1	1	2	-	1	2	1
CO-2	1	2	1	2	1	1	1	1	1	1	1	2
CO-3	1	1	-	1	2	-	1	1	1	2	2	1
CO-4	1	2	1	2	1	1	1	1	-	1	2	2
CO-5	2	1	1	1	-	1	2	2	1	1	1	2

Unit - I

Introduction: Evolution of the private equity industry. Private Equity Financing: Meaning, Nature and Objectives. The Private Equity Financing Process: Determining the size of the Fund, Fund Raising, Sourcing Portfolio Investments (including Banking), Acquiring the Portfolio Companies, Converting Equity Value back to Cash by liquidating portfolio holdings. Venture Capital Funding. The Role of Private Equity in Portfolio Construction.

Unit - II

Private Equity Investors: Types of Investors: Private Equity Funds, Fund Investors, Co-investors, Fund of funds, General Partners, Limited Partners, Financial Advisors. The objectives and perspectives of investors in private equity funds. Incentives of investors in private equity funds. Information problems of investors in private equity funds. Compensation in Private Equity Partnerships.

Unit - III

Valuation and Capital Structure

Concept of Leverage – Operating, Financial and Combined Leverage. Valuation techniques in a highly leveraged setting: Leveraged Buyout Structure and the Target Internal Rate of Return Method of Valuation, The Equity Cash Flow Method of Valuation Using Capital Asset Pricing Method. Value Creation by Private Equity Firms: Multiple Expansion, Leverage and Operational Improvements.

Unit - IV Financial Issues

Financial Issues in Private Equity Firms related to Product and market strategies, Private equity partners, Portfolio Management, Compensation, Corporate strategy, and Going public. Due Diligence: Concept, Process, Quality of Earnings (Q of E) assessment, Legal due diligence, Operational due diligence, Due diligence checklist, Developing exit strategy.

Unit - V Corporate Governance and Ethics

Cultural, Legal, Ethical and Moral issues surrounding the use of Private Equity. Matters of Confidentiality, Transparency, Corporate Governance, and Self-regulation. Legal and ethical responsibilities of Corporate Directors and Officers, Executives, Managers and Employees at all levels. Governance Failures (case studies).

Text Books:

1. Zeisberger Claudia , Prahl Michael , White Bowen , "Mastering Private Equity" 1st Ed. Wiley, UK, 2017.
2. Finkel Robert , Greising David , "The Masters of Private Equity and Venture Capital", 1st Ed. McGraw Hill Professional, New Delhi 2009.
3. Faircloth Matt "Raising Private Capital: Building Your Real Estate Empire Using Other People's Money", 8th Edition, Bigger Pockets Publishing, USA, 2018.
4. Demaria Cyril, "Introduction to private equity-Venture, Growth, LBO & Turn-Around Capital" 2nd Ed. Wiley, USA, 2006.

Suggested Readings:

1. Gilligan John, "Private Equity Demystified", 4th Ed., Oxford University Press", Delhi, 2020.
2. Stowell David P., "An Introduction to Investment Banks, Hedge Funds & Private Equity", Elsevier Academic Press, USA, 2010.
3. Fernando A.C., "Business Ethics and Corporate Governance", 2nd Ed., Pearson Publishers, 2010.
4. Khanka SS, "Business Ethics and Corporate Governance", 1st Ed, S Chand Publishing, New Delhi, 2015.
5. Scharfman JA, "Private Equity Operational Due Diligence", 1st Ed, John Wiley & Sons Inc., USA, 2012.
6. Greenwald Bruce and Kahn Judd, "Competition Demystified: A Radically Simplified Approach to Business Strategy", 1st ed, Portfolio Publisher, Canada, 2007.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF ARTIFICIAL INTELLIGENCE &MACHINE LEARNING

OPEN ELECTIVES

S No	Course Code	Title of the Course
1	22CAO01	Foundations of Artificial Intelligence and Machine Learning
2	22CAO02	Ethical Intelligence
3	22CAO03	Foundations of Deep Learning

22CAO01

FOUNDATIONS OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Probability and Statistics

COURSE OBJECTIVES: This course aims to

1. The objective of the course is to provide a strong foundation of fundamental concepts in Artificial Intelligence
2. A basic exposition to the goals and methods of Artificial Intelligence, and fundamentals of machine learning

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Enumerate the history and foundations of Artificial Intelligence.
2. Apply the basic principles of AI in problem solving.
3. Choose the appropriate representation of Knowledge.
4. Enumerate the Perspectives and Issues in Machine Learning.
5. Identify issues in Decision Tree Learning.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1	1	-	2	-	2	1	1	-	1
CO 2	1	2	-	-	-	1	-	1	-	-	-	1
CO 3	1	1	1	-	-	-	1	1	-	-	-	1
CO 4	2	2	-	-	1	-	1	2	1	1	1	2
CO 5	1	1	1	1	1	2	1	1	2	1	1	2

UNIT- I

Introduction: What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

UNIT - II

Problem Solving: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions.

UNIT - III

Knowledge Representation: Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, The Internet Shopping World.

UNIT - IV

Introduction to Machine Learning: Well-Posed Learning Problem, Designing a Learning system, Perspectives and Issues in Machine Learning. Concept Learning and The General-to-Specific Ordering: Introduction, A Concept Learning Task, Concept Learning as Search, FIND-S: Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Remarks on Version spaces and Candidate-Elimination, Inductive Bias

UNIT - V

Decision Tree Learning: Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm, Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Pearson.
2. Tom M. Mitchell, Machine Learning, McGraw Hill Edition, 2013

REFERENCE BOOKS:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill.
1. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.)
2. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.
3. Christopher Bishop, Pattern Recognition and Machine Learning (PRML) , Springer, 2007.
4. ShaiShalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms (UML) , Cambridge University Press, 2014.

E-RESOURCES:

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106106126
3. https://aima.cs.berkeley.edu
4. https://ai.berkeley,edu/project_overview.html
5. http://www.zuj.edu.jo/download/machine-learning-tom-mitchell-pdf/
6. http://www.ntu.edu.sg/home/egbhuang/pdf/ieee-is-elm.pdf
7. https://swayam.gov.in/nd1_noc20_cs73/preview

22CAO02

ETHICAL INTELLIGENCE

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Not required

COURSE OBJECTIVES: This course aims to

1. To learn conceptual framework for analyzing ethical issues that AI systems and algorithms, pose to our society.
2. To provide a good understanding of the foundations of modern and ancient approaches to ethics and their differences.
3. Applying knowledge and understanding of AI in information transmission and processing.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Enhance and apply their understanding of ethics broadly.
2. Gain familiarity with the problems of ethics.
3. Come up with possible solutions, specifically related to algorithms and AI.
4. Apply their ethical understanding in analyzing cases involving AI.
5. Can apply ethical understanding to any field like social media, data etc.

CO-PO Articulation Matrix:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	1	1	2	2	2	2	-	2	-	3
CO 2	1	2	-	-	-	1	-	-	2	2	2	2
CO 3	1	2	2	2	-	-	1	2	-	2	-	1
CO 4	2	2	-	2	1	2	1	1	1	2	2	2
CO 5	1	1	2	2	1	2	1	2	2	2	1	2

Unit-I

Introduction: Definition of morality and ethics in AI, Impact on society, Impact on human psychology, Impact on the legal system, Impact on the environment and the planet, Impact on trust.

Software Qualities and Normative Ethics: Interpretability, transparency, and normative ethics, Interpretability, transparency, and policy making, Extensibility, usability, and communicability.

Unit-II

AI and Ethics- Challenges and Opportunities: Challenges, Opportunities- AI Technologies, ethical issues in artificial intelligence, Societal Issues Concerning the Application of Artificial Intelligence in Medicine, Decision-making role in industries, National and International Strategies on AI.

Unit-III

AI Standards and Regulation: Model Process for Addressing Ethical Concerns during System Design, Transparency of Autonomous Systems.

Data Privacy Process: Algorithmic Bias Considerations, Ontological Standard for Ethically Driven Robotics and Automation Systems.

Unit-IV

Ethics of information and Ethics of AI: Ethical issues for different strengths/grades of AI and AI algorithms, Ethics of AI on the Web and in Web based applications, AI technology and social hierarchy.

Normative ethics proposals: Advantages and disadvantages, Care ethics, Virtue Ethics, Problems with implementation, Problems with uptake and enforcement.

Unit-V

AI, Information transmission, Information processing, and Privacy.

Big data and privacy: Big data and human identity, Gender and cultural bias.

Black boxes: Big data, Recurrent Neural Nets, Black boxes, and social construction

Text Books:

1. John C. Havens "Heartificial Intelligence: Embracing Our Humanity to Maximize Machines Paperback "– Illustrated, 2 February 2016.
2. Patrick Lin, Keith Abney, George A Bekey, "Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.
3. Ethics, Moral Philosophy, and AI Bauer, W. A. (2020). "Virtuous vs. utilitarian artificial moral agents. AI and Society". Bryson, J. J. (2018)..

Suggested Reading:

1. Michael J. Quinn "Ethics for the Information Age"
2. Mark coeckelbergh " AI Ethics"

E-RESOURCES:

1. NPTEL :: Humanities and Social Sciences - NOC: Towards an Ethical Digital Society: From Theory to Practice
   https://archive.nptel.ac.in/courses/109/106/109106184/
2. AI Ethics https://www.coursera.org/articles/ai-ethics
3. Ethical Intelligence: Change the Way You Live Your Life

   https://www.udemy.com/course/ethical-intelligence-change-the-way-you-live-your-life/?couponCode=NVDPRODIN35

22CAO03

FOUNDATIONS OF DEEP LEARNING

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Calculus, Probability and Statistics, Python Programming, Machine Learning.

COURSE OBJECTIVES: This course aims to

1. Provide students with a foundational understanding of the history of deep learning, key concepts, and early neural network models.
2. Equip students with the skills to design and optimize feedforward neural networks using various gradient descent methods and optimization algorithms.
3. Develop students' competence in applying principal component analysis, singular value decomposition, and different types of autoencoders for data representation and regularization.
4. Enable students to design, implement, and apply convolutional neural networks (CNNs) for image and data processing tasks.
5. Enhance students' ability to design and apply recurrent neural networks (RNNs) and attention mechanisms for complex sequence modeling tasks.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Demonstrate a comprehensive understanding of deep learning history, key milestones, and foundational concepts.
2. Design, develop, and optimize feedforward neural networks and understand their representation power.
3. Apply principal component analysis, singular value decomposition, and various autoencoder models for data analysis and dimensionality reduction.
4. Develop and implement convolutional neural networks (CNNs) using modern architectures and techniques.
5. Design and utilize recurrent neural networks (RNNs) and advanced attention mechanisms for sequential data processing.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	2	2	1	1	1	1	2	1	1
CO 2	3	3	3	3	3	1	1	1	1	2	2	2
CO 3	3	3	3	3	3	1	1	1	1	2	2	2
CO 4	3	3	3	3	3	1	1	1	1	2	2	2
CO 5	3	3	3	3	3	1	1	1	1	2	2	2

Unit-I

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent.

Unit-II

Feedforward Neural Networks, Representation Power of Feedforward Neural Networks Feed Forward Neural Networks, Backpropagation Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors, Eigenvalue Decomposition, Basis

Unit-III

Principal Component Analysis and its interpretations, Singular Value Decomposition Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive autoencoders

Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout

Unit-IV

Convolutional Neural Network: The Convolution Operation, Motivation, Pooling, Convolution and Pooling, Batch Normalization.

Pre-trained models: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

Unit-V

Recurrent Neural Networks, Vanishing and Exploding Gradients, GRU, LSTMs. Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Books:

1. Goodfellow. I., Bengio. Y. and Courville. A., "Deep Learning ", MIT Press, 2016.
2. Rothman, Denis, "Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more", Packt Publishing Ltd, 2021.
3. Ganguly Kuntal, "Learning generative adversarial networks: next-generation deep learning simplified", Packt Publishing, 2017

Suggested Reading:

1. Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.
2. Bishop, Christopher M. Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2
3. Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.
4. Mitchell, Tom. Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.
5. Richard Hartley, Andrew Zisserman, Multiple View Geometry in Computer Vision, 2004. David Marr, Vision, 1982.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs41/
2. https://onlinecourses.nptel.ac.in/noc22_cs22/
3. https://onlinecourses.nptel.ac.in/noc19_cs85

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
SCHEME OF INSTRUCTIONS AND EXAMINATION

(Inline with AICTE Model Curriculum with effect from AY 2024-25)

(R22 and R22A Regulation)

Department of Computer Science and Engineering

Open Electives

S. No	Course Code	Title of the Course
1.	22CSO01	Introduction to Web Technologies
2.	22CSO02	Introduction to Database Management Systems
3.	22CSO03	Software Testing Methodology
4.	22CSO04	Web Programming With JavaScript
5.	22CSO05	Fundamentals of Java Programming

L: Lecture **T: Tutorial** **P: Practical**
CIE: Continuous Internal Evaluation **SEE-Semester End Examination**

22CSO01

INTRODUCTION TO WEB TECHNOLOGIES
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on a programming language.

COURSE OBJECTIVES: This course aims to

1. Acquire knowledge on HTML, Java Script and XML to develop client side web applications.
2. Learn developing web applications using Django.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Understand the technologies required for developing web application.
2. Identify and choose HTML tags, CSS and java scripts to develop well-structured and easily maintained web pages.
3. Design and Develop interactive and innovative web pages using various platforms/technologies like HTML, CSS, XML, JAVASCRIPT.
4. Create and deploy web applications in web server by using Django concepts.
5. Evaluate different web applications to implement optimal solutions for real time problems

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	2	2	1	1	1	1	2	3	1	3
CO 2	2	3	2	2	1	1	1	1	2	3	1	3
CO 3	2	3	2	2	1	1	1	1	2	3	1	3
CO 4	2	3	2	2	1	1	1	1	2	3	1	3
CO 5	2	3	3	2	1	1	1	1	2	3	1	3

UNIT - I
Web Basics: WWW Browsers, Web Servers, URL, MIME, HTTPS.
Introduction HTML5: basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. Grid, Cascading Style Sheets.

UNIT – II
The Basics of Java script: Primitive operations and Expressions, Arrays, Functions, Pattern Matching Using Regular Expressions, Document Object Model, Element Access in JavaScript, Events and Event Handling, Handling Events from Body, Button, Text Box and Password Elements.
Dynamic Documents with Java Script: Positioning Elements, Moving Elements, float and clear.

UNIT - III
XML: Introduction, uses of XML, the Syntax of XML, XML Document Structure, Namespaces, XML schemas, displaying Raw XML Documents, displaying XML documents with CSS, JSON, XML vs JSON.

UNIT - IV
Django: Introduction, Models, Templates, supported data bases, URL configuration. Templates, Modifying and Improving the Templates, Creating a Form.

UNIT - V
Applications: Introduction to Ajax, Node.js.
Bootstrap: Introduction to Bootstrap, bootstrap grid, bootstrap components.
Web Application Frameworks: React JS, JQuery.

Text Books:

1. HTML5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery), Dreamtech, 2017.
2. Adrian Holovaty and Jacob Kaplan-Moss, "The Definitive Guide to Django Web Development Done Right", après-2009
3. P. J. Deitel - Deitel, H. M. Deitel - Deitel, "Internet & World Wide Web How to Program", 5th Edition, Prentice Hall, 2007.
4. Miguel Grinberg, "Flask Web Development", 1st Edition-2014.

Suggested Reading:

1. Uttam K Roy, "Web Technologies", Oxford University Press.
2. Chris Bates, "Web Programming, building internet applications", 2nd Edition, John Wiley & Sons, 2010.
3. Alok Ranjan, Abhilasha Sinha, Ranjit Battwad, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript", BPB, 2020.

Online Resources:

1. https://www.w3.org/standards/webdesign/
2. https://www.w3schools.com/angular/
3. https://www.w3schools.com/jquery/default.asp
4. https://www.tutorialspoint.com/flask/index.htm
5. https://www.tutorialspoint.com/web2py/index.htm
6. https://www.tutorialspoint.com/fuelphp/index.htm

22CSO02

INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Learn data models, conceptualize and depict a database system using E-R diagrams.
2. Understand the internal storage structures in a physical DB design.
3. Learn the fundamental concepts of transaction processing techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Understand the fundamental concepts of database and design using ER model.
2. Apply SQL to find solutions to basic queries.
3. Identify the inference rules for functional dependencies and apply the principles of normal forms to decompose the relations in a database.
4. Understand the concepts like data storage, indexing and transaction processing.
5. Analyze concurrency control and recovery mechanisms.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	-	1	-	-	-	-	-	-	-	2
CO 2	3	2	1	2	-	-	-	-	-	-	-	1
CO 3	3	2	1	1	-	-	-	-	-	-	-	1
CO 4	3	3	1	2	-	-	-	-	-	-	-	1
CO 5	3	2	1	2	2	-	-	-	-	-	-	2

UNIT - I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators Database System Architecture, Application Architectures.
Database Design and E-R Model: Basic concepts, Constraints, E-R Diagrams, E-R Design Issues, Extended E-R Features, Specialization and Generalization.

UNIT - II

Relational Model: Structure of Relational Databases, Database Schema, Keys.
Structured Query Language: Overviews, SQL Data Types, SQL Queries, Data Manipulation Language Set Operations, Aggregate Functions, Data Definition Language, Integrity Constraints, Null Values, Views, Join Expression.

UNIT - III

Relational Database Design: Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Closure of Set of Attributes, Irreducible Set of Functional Dependencies, Normalization – 1NF, 2NF, and 3NF, Dependency Preservation, BCNF, Comparison of BCNF and 3NF.

UNIT - IV

Indexing: Basic concepts, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+ Tree Index Files.
Transaction Management: Transaction Concept – ACID Properties, States of Transaction, Implementation of Atomicity and Durability, Serializability.

UNIT - V

Concurrency Control: Introduction, Lock-Based Protocols, Timestamp-Based Protocols.
Deadlocks Handling: Deadlock Detection and Prevention.
Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery.

Text Books:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", McGraw-Hill International Edition, 6th Edition, 2011.
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Pearson Education, 8th Edition, 2006.

Suggested Reading:

1. Raghu Ramakrishnan, JohnnesGehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2003.
2. Ramez Elmasri, Durvasul VLN Somayazulu, Shamkant B Navathe, Shyam K Gupta, "Fundamentals of Database Systems", Pearson Education, 4th Edition, 2006.

Online Resources:

1. https://nptel.ac.in/courses/106104135

22CSO03

SOFTWARE TESTING METHODOLOGY
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Software engineering

COURSE OBJECTIVES: This course aims to

1. Understand the importance of software testing in the software development lifecycle.
2. Learn various software testing methodologies and techniques.
3. Gain hands-on experience with industry-standard testing tools.
4. Develop the skills to design and execute comprehensive test plans.
5. Analyze and interpret test results to improve software quality.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. List a range of different software testing techniques and strategies and be able to apply specific (automated) unit testing methods to the projects.
2. Distinguish characteristics of structural testing methods.
3. Demonstrate the integration testing which aims to uncover interaction and compatibility problems as early as possible.
4. Discuss the functional and system testing methods.
5. Demonstrate various issues for object-oriented testing.

CO-PO Articulation Matrix

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	-	-	-	-	-	-	-	1	-
CO 2	3	2	2	2	-	-	-	-	2	-	-	-
CO 3	2	2	3	2	-	-	-	-	2	-	-	-
CO 4	3	3	2	-	-	-	-	-	-	-	-	-
CO 5	2	2	3	2	2	2	-	-	-	-		1

UNIT - I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.
Flow graphs and Path testing: Basic concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: Transaction flows, transaction flow testing techniques. Dataflow testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.
Domain Testing: domains and paths, Nice & ugly domains, domain testing, domain and interface testing, domains and testability.

UNIT - III

Paths, Path products and Regular expressions: Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.
Logic-Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT - IV

State, State Graphs and Transition testing: State graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

Text Books:

1. Boris, Beizer, "Software Testing Techniques", 2nd Edition, Dreamtech, 2003.
2. Dr. K. V. K. K. Prasad, "Software Testing Tools", 2nd Edition, Dreamtech, 2005.

Suggested Reading:

1. Brian Marick, "The craft of Software Testing", 3rd Edition, Pearson Education, 2009.
2. Software Testing Techniques – SPD(Oreille)
3. Edward Kit, "Software Testing in the Real World", 2nd Edition, Pearson, 1995.
4. Perry, "Effective Methods of Software Testing", 2nd Edition, John Wiley, 2006.
5. Meyers, "Art of Software Testing", 4th Edition, John Wiley, 2004.

Online Resources:

1. https://www.coursera.org/courses?query=software%20testing
2. https://nptel.ac.in/courses/106101163

22CSO04

WEB PROGRAMMING WITH JAVASCRIPT
(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Problem Solving and Programming, Object Oriented Programming.

COURSE OBJECTIVES: This course aims to

1. Write and debug JavaScript
2. Interact with the Document Object Model (DOM) using JavaScript
3. Experience the role of JavaScript in HTML5

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Understand the technologies required for developing web application like HTML and JavaScript.
2. Identify and choose HTML tags, CSS and java scripts to develop well-structured and easily maintained web pages.
3. Develop web pages using Object Oriented concepts.
4. Choose appropriate DOM methods and properties to access HTML elements.
5. Design and Develop interactive and innovative web pages using various platforms/technologies like HTML, CSS, and JAVASCRIPT.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	2	2	-	-	-	-	-	-	-	-
CO 2	2	3	2	2	-	-	-	-	-	-	-	-
CO 3	2	3	2	2	-	-	-	-	-	-	-	-
CO 4	2	3	2	2	-	-	-	-	-	-	-	-
CO 5	2	3	3	2	-	-	-	-	-	-	-	-

UNIT - I

Web Basics: WWW Browsers, Web Servers, URL, MIME, HTTPS.
Introduction HTML5: basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. Grid, Cascading Style Sheets.

UNIT - II

The Basics of Java script: Variables, Primitive data types, Converting Datatypes, Operators, Expressions, Arrays properties and methods, Multi-dimensional Arrays, Logic Statements, Loops, Functions, Variable Scope in Functions.

UNIT - III

Object oriented programming: Classes, Objects, Constructors, Methods, and Properties.
Intermediate JavaScript: Pattern Matching Using Regular Expressions, Functions and the argument objects, JavaScript hoisting, using strict mode, JSON.

UNIT - IV

Document Object Model(DOM): Basic DOM traversing, Element Access in the DOM, Events and Event Handling, Handling Events from Body, Button, Text Box and Password Elements.
Dynamic Documents with Java Script: Positioning Elements, Moving Elements, Dynamic Content.

UNIT - V

Built-In JavaScript Methods: Parsing Numbers, Array Methods, String Methods, Number Methods, Math Methods, Date Methods.

Text Books:

1. HTML5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery), Dreamtech, 2017.
2. Laurence Lars Svekis, Maaike van Putten and Rob Percival, "JavaScript from Beginner to Professional: Learn JavaScript quickly by building fun, interactive, and dynamic web apps, games, and pages", Packt publishing Ltd.
3. Marijn Haverbeke, "Eloquent JavaScript: A Modern Introduction to Programming", 2024, 4th Edition, No Starch Press, USA.

Suggested Reading:

1. Uttam K Roy, "Web Technologies", Oxford University Press.
2. Chris Bates, "Web Programming, building internet applications", 2nd Edition, John Wiley & Sons, 2010.
3. Alok Ranjan, Abhilasha Sinha, Ranjit Battwad, "JavaScript for Modern Web Development: Building a Web Application Using HTML, CSS, and JavaScript", BPB, 2020.

Online Resources:

1. https://www.w3schools.com/js/
2. https://www.tutorialspoint.com/javascript/index.htm
3. https://www.javatpoint.com/javascript-tutorial
4. https://www.geeksforgeeks.org/javascript/
5. https://www.programiz.com/javascript
6. https://javascript.info/

22CSO05

FUNDAMENTALS OF JAVA PROGRAMMING
(Open Elective)

Instruction	3 L Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: any Programming Language, Object Oriented Language.

COURSE OBJECTIVES: This course aims to

1. Provide an introduction to Object oriented Programming Concepts
2. Introduce the different features of Java Programming
3. Provide some theoretical concepts on predefined classes in java

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Apply Object Oriented Programming Concepts like classes, inheritance, polymorphism
2. Understand the reusability of code using packages and classes
3. Apply the features of java programming like interfaces, exceptions and threads
4. Develop applications using collection frameworks
5. Use the predefined packages like java.util and java.lang

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	-	-	-	-	-	-	-	-	-
CO 2	2	2	2	-	-	-	-	-	-	-	-	-
CO 3	2	2	2	-	-	-	-	-	-	-	-	-
CO 4	2	2	2	-	-	-	-	-	-	-	-	-
CO 5	2	2	2	-	-	-	-	-	-	-	-	-

UNIT - I

Java Programming- History of Java, Java buzzwords, OOP Concepts, Data types, Variables, Constants, Scope and Life time of variables, Operators, Type conversion and casting, Control Flow Statements, arrays, simple java programs.

Classes and Methods: concepts of classes, objects, methods, constructors, access control, this keyword, overloading methods and overloading constructors, garbage collection, recursion.

UNIT - II

Inheritance – Inheritance Basics, using Super, Types of Inheritance.

Polymorphism – Method Overriding, Dynamic Method dispatching, abstract classes and methods. Using Final with Inheritance, the Object Class.

UNIT - III

Interfaces-Interfaces Vs Abstract classes, defining an interface, implement interfaces, extending interface.

Packages- Defining, creating and accessing a package, importing packages.

UNIT - IV

Exception handling – Exception Handling Fundamentals, Exception Types, try, Catch, throw, Throws , Finally built-in exceptions, Create your own exception class.

Multi-threading- thread life cycle, creating threads, synchronizing threads.

UNIT - V

Files- Streams, Byte streams, Character streams, Text input/output.

Java.util package: Collection classes-ArrayList, List, TreeSet, Iterator, HashMap ,StringTokenizer class,

Java.lang- String Class.

Text Books:

1. Java- The Complete Reference, 10th Edition, Herbert schildt, TMH.
2. Y Daniel Liang, Introduction to java Programming, Comprehensive Version, Global Edition
3. E Balagurusamy , Programming with Java 7th Edition

Suggested Reading:

1. T. Budd, Understanding OOP with Java, updated edition, Pearsoneducation.
2. Dr. R.NageswaraRao , Core Java an integrated approach, dreamtech publication.
3. P. Radha Krishna ,Object Oriented Programming through Java, Universities Press.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(AUTONOMOUS)

AICTE Model Curriculum with effect from AY 2022-23

DEPARTMENT OF IT

OPEN ELECTIVES

S. No	Course Code	Title of the Course
1.	22ITO01	OBJECT ORIENTED PROGRAMMING USING JAVA
2.	22ITO02	OBJECT ORIENTED PROGRAMMING THROUGH C++
3.	22ITO03	INTRODUCTION TO CLOUD COMPUTING

22ITO01 **OBJECT ORIENTED PROGRAMMING USING JAVA**

(Open Elective)

Instruction		3 L Hours per week
Duration of SEE		3 Hours
SEE		60 Marks
CIE		40 Marks
Credits	3	

COURSE OBJECTIVES: This course aims to

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To acquaint with Exception handling mechanisms and Multithreading.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize web application environment using Servlets and JSP

COURSE OUTCOMES: After the completion of this course, the student will be able

1. To understand fundamentals of object-oriented programming paradigm.
2. To apply knowledge of string handling, interfaces, packages and inner classes.
3. To implement Exception handling mechanisms and Multithreading.
4. To demonstrate knowledge on collection framework, stream classes.
5. To develop web applications using Servlets and JSP.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	1	-	-	-	-	-	-	2	-	-
CO2	2	1	3	2	2	3	3	-	-	1	-	1
CO3	2	2	3	2	2	3	3	-	-	1	-	1
CO4	2	2	3	2	2	3	3	-	-	1	-	1
CO5	2	2	3	3	3	3	3	-	1	1	1	1

UNIT-I

OOP concepts: Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses, Member access rules ,super keyword**,** Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces: Defining and implementing interfaces, Nested Interfaces. **Strings Handling:** String & StringBuffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types**,** Usage of try, catch, throw, throws and finally clauses, writing your own exception classes. **Multi-threading in Java:** The java Thread Model, How to create threads, Thread class in java, Thread priorities, Thread synchronization.

Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV

Collections Framework: Overview of Collection Framework, Commonly used Collection classes – Array List, Linked List, Hash Set, LinkedHashSet, Tree Set, Collection Interfaces –Collection, List, Set, Sorted Set, Accessing a collection via an Iteration, Storing user-defined classes in collections, Map Interfaces and Classes, Using a comparator. Legacy classes – Vector, Hash table, The Enumeration interface.

Input/Output : How to read user input (from keyboard) using scanner class,Stream classes, InputStream, OutputStream, FileInputStream, FileOutputStream, Reader and Writer, FileReader, FileWriter classes. File class.

UNIT-V

Java Servlets: Overview of Java Servlet API, Servlet Implementation, Servlet Configuration, Servlet Exceptions, Servlet Life cycle, Request and Response methods, Approaches to Session tracking, Servlet Context, Servlet Collaboration.

JSP Basics: Introduction to JSP, Directives, Scripting Elements, Standard Actions.

Databases: Connect servlet to MySQL, Connect JSP to MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8th Edition, Tata McGraw Hill Publications, 2011.
2. Kathy Sierra, Bryan Basham, Bert Bates, ―Head First Servlets and JSP‖, 2nd Edition, O'Reilly Media, Inc, 2008.

Suggested Reading:

1. E Balagurusamy "Programming with JAVA", 6th Edition, Tata McGraw-Hill Publishing company Ltd,2019.
2. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2nd Edition, Oxford University Press, 2014.
3. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4th Edition, Tata McGraw-Hill Publishing company Ltd., 2010. 4. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide"2nd Edition, O'Reilly,2005

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-092- introduction-to-programming-in-java-january-iap-2010/lecture-notes/

22ITO02 **OBJECT ORIENTED PROGRAMMING THROUGH C++**

(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Prerequisites: Programming and Problem Solving (C language).

COURSE OBJECTIVES: This course aims to

1. Understand the syntax and semantics of the C++ programming language.
2. Comprehend the principles behind designing C++ classes for code reuse.
3. Apply the concepts of overloading, inheritance, and exception handling in practical programming scenarios.
4. Examine and understand the concept of dynamic binding within C++ programs.
5. Assess and compare different approaches to stream computation and understand the usage of generic classes in C++ programming.

COURSE OUTCOMES: After the completion of this course, the student will be able

Understand the distinctions between OOP and procedural programming paradigms.

1. Identify and utilize suitable OOP concepts for designing and implementing solutions to computational problems.
2. Apply overloading, inheritance, and exception handling in practical programming to solve real-world problems effectively.
4. Demonstrate stream computation using files and generic programming using templates.
5. Develop robust programs using OOPS concepts to solve real world problems.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	1	0	0	0	0	0	0	0	0	2
CO2	2	2	1	0	0	0	0	0	0	0	0	2
CO3	2	3	2	0	0	0	0	3	0	0	0	2
CO4	2	3	2	0	0	0	0	3	0	0	0	2
CO5	2	3	2	0	0	0	0	3	0	0	0	2

UNIT-I

Object-Oriented Paradigm- OOPS- A new Paradigm, Evolution of Programming Paradigms, Moving from C to C++ Data Types, Operators and Expressions, Control Flow, Strings Modular Programming with Functions- Function Components, Passing Data to Functions, Function Return Data Type, Parameter Passing, Return by Reference, Default Arguments, Inline Functions, Function Overloading, Function Templates, Functions with Variable Number of Arguments, Recursive Functions.

UNIT-II

Classes and Objects: Class Specification, Class Objects, Accessing Class Members, Member Functions, Outside Member Functions as Inline, Data Hiding, Empty Class, Passing Objects as Arguments, Friend Function and Friend Classes, Static Data Members and Member Functions.

Object Initialization: Constructors—Parameterised Constructors, Destructor, and Copy Constructor.

UNIT-III

Operator Overloading Over loadable Operators, Unary Operator Overloading, Binary Operator Overloading, Arithmetic Operators, Concatenation of Strings, Comparison Operators, Assignment Operators.

Inheritance: Derived Class Declaration, Forms of Inheritance, Constructors and Destructors in derived classes, Types of Inheritances.

Exception Handling: Error Handling, Lists of exceptions, catchall exceptions.

UNIT-IV

Virtual Functions: Need for virtual functions, Pointer to derived class objects, definition of virtual functions, Array of pointers to base class objects, pure virtual functions, Abstract classes, Virtual destructors, Dynamic Binding.

Streams Computation with Console: Introduction, Predefined console streams, Hierarchy of console streams, unformatted and formatted I/O operations.

UNIT-V

Streams Computation with Files: Introduction, Hierarchy of File stream classes, opening and closing of files, file modes, file pointers and their manipulators, Sequential and Random access to a file.

Generic Programming with Templates: Function template, Overloaded function templates, Nesting of function calls, Multiple arguments function template.

Text Books:

1. K.R.Venugopal, RajkumarBuyya, "Mastering C++", 2/e, TMH, 2016.
2. Paul Deitel, Harvey Deitel, "How to Program C++", 9th edition, Pearson, 2013.

Suggested Reading:

1. Bjarne Stronusstrup, "The C++ Programming Language", 4/e, Pearson, 2013.
2. Sourav Sahay, "Object Oriented Programming with C++", 2/e, Oxford University Press

Web Resources:

1. https://www.tutorialspoint.com/cplusplus/
2. https://www.programiz.com/cpp-programming
3. https://www.class-central.com/tag/c++

22ITO03 **INTRODUCTION TO CLOUD COMPUTING**

(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To impart the basics of cloud computing for business management.
2. To illustrate and explore the benefits of cloud storage and its applications, usage by managers.
3. To enable students explore cloud computing driven real time systems.

COURSE OUTCOMES: After the completion of this course, the student will be able

Upon completing this course, students will be able to:

1. Understand the characteristics and models in Cloud computing.
2. Asses Cloud services applications and the challenges associated with Cloud Computing.
3. Apply various cloud services and deployment models and virtualization techniques for business.
4. Analyze the concepts of cloud storage and demonstrate their use.
5. Evaluate various cloud programming models and apply them in virtual office management.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	1	-	-	-	1	1	1	1
CO2	2	1	2	1	2	-	-	-	-	-	1	-
CO3	2	1	2	2	1	-	-	-	-	-	-	-
CO4	2	1	1	1	1	-	-	-	-	-	-	1
CO5	2	1	1	1	1	-	-	-	-	-	-	1

UNIT-I

Cloud Computing Overview: Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling , Rapid elasticity , Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT-II

Cloud Insights: Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability ,simplicity ,vendors ,security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies.

UNIT-III

Cloud Architecture- Layers and Models: Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption.

Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT-IV

Cloud Simulators- CloudSim and GreenCloud : Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

UNIT-V

Introduction to VMWare Simulator: Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Text Book:

1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter, "Cloud computing a practical approach", TATA McGraw- Hill , New Delhi – 2010

Suggested Reading:

1. Michael Miller – Que, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Onlin", 2008
2. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud computing for dummies", Wiley Publishing, Inc, 2010
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, "Cloud Computing (Principles and Paradigms)", Inc. 2011

Web Resource:

1. https://nptel.ac.in/courses/106105167/1

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of I Semester of B.E. – Artificial Intelligence and Data Science

(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	22ADO01	INDUSTRY 5.0: APPLICATIONS OF AI
2.	22ADO02	DATA SCIENCE USING PYTHON
3.	22ADO03	FREE AND OPEN SOURCE SOFTWARE

22ADO01

INDUSTRY 5.0: APPLICATIONS OF AI

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: THIS COURSE AIMS TO

1. To introduce Artificial Intelligence in detail from its basics to future applications and tools of Industry 5.0
2. To provide insights on technological advancements and focus on preparing students and researchersfor Industry 5.0
3. To impart the importance of AI technologies in assistive technology
4. To discuss the available applications of AI for promoting early diagnosis of diseases
5. To understand the various AI technologies

COURSE OUTCOMES:

1. Summarize the evolution, current applications, and future challenges of artificial intelligence.
2. Evaluate the foundational elements and impacts of AI within machine learning paradigms.
3. Analyze AI's effectiveness in diagnosing diseases and enhancing assistive technology.
4. Design AI-driven solutions for modernizing and improving agricultural practices.
5. Assess AI's role in advancing radiotherapy techniques and ensuring quality assurance.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	2	2	1	2	1	2	3
CO2	3	3	3	3	1	2	2	1	2	1	2	3
CO3	3	3	3	3	1	2	2	1	2	1	2	3
CO4	3	3	3	3	1	2	2	1	2	1	2	3
CO5	3	3	3	3	1	2	2	1	2	1	2	3

UNIT: 1

Artificial Intelligence Insight: Artificial Intelligence: What and Why, History of AI, What is AI?,The Basics, AI Environment, Challenges in AI, Current work in AI for environment, Customer Experience (CX) and the use of AI,Future of AI, Future challenges in AI

UNIT: 2

Influence of AI in Machine Learning: Definition, What is Machine Learning, Importance of Machine Learning, Types of Machine Learning, Approaches of Machine Learning - Machine Learning Algorithm, Programming Languages, Frameworks, Databases, Deployment tools, Methodology for Model Building, Machine learning methods, Statistical Measures, Application areas of Machine Learning, Medical Machine Learning, Influence of AI and ML in Clinical and Genomic Diagnostics.

UNIT: 3

Artificial Intelligence in Healthcare sector & Assistive Technology (AT): AI in diagnosis of Genetic Diseases, Cancer, Diabetes, AI in Diagnosis of Syndrome, AI in diagnosis of Psychiatric Disorders, Depression, Alzheimer's Disease, Autism Spectrum Disorder, Anxiety, Parkinson's Disease, AI in other Diagnosis, Infectious, Lung and Brain Disease, Case studies on AI in systems Biology, AI technologies in Systems Biology towards Pharmacogenomics, AI in Systems Biology for Cancer Cure, Applications of AI for COVID-19 Pandemic, Transformative impact of AI on AT, AI experience and AT for disables people in India, AI Powered technology for an inclusive world .

UNIT: 4

Artificial Intelligence in Agriculture: Need of AI in Agriculture, Emerging Agricultural Technologies, Soil and water sensors, Weather Tracking, Satellite Imaging Agriculture, Automation Systems, RFID Technology, Potential Agricultural Domain for Modernization, AI transformation in Agricultural Scenarios.

UNIT: 5

Artificial Intelligence in Radiotherapy: Importance of Artificial Intelligence in Radiotherapy , AI tools forautomated treatment planning (ATP), Present ATP techniques, AI applications, Advancements and ResearchGuidance in ATP, AI challenges in ATP, AI in Intensity-modulated Radiotherapy (IMRT), AI for IMRT DoseEstimation, AI for IMRT Planning Support, AI for Modeling IMRT outcome and plan deliverability, AI for AUTO-Segmentation of OAR in IMRT, AI in Brachytherapy, AI in Radiotherapy Quality Assurance, Challenges associatewith AI for Quality Assurance in RT, Future directions to improve AI-based Quality Assurance in RT, AI inRadiation Biology, AI in Radiation Protection/Safety, Motivations to develop AI-Based systems for Radiation protection.

TEXTBOOK:

1. Kaliraj, P., & Devi, T. (Eds.). (2021). Artificial Intelligence Theory, Models, and Applications (1st ed.). CRC Press, Taylor & Francis Group, Boca Raton, ebook ISBN 9781032008097 Auerbach Publications. https://doi.org/10.1201/9781003175865

22ADO02

DATA SCIENCE USING PYTHON

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: THIS COURSE AIMS TO

1. To familiarize the data scientists, work environment like IPython and Jupyter.
2. To understand ndarray object for efficient storage and manipulation of dense data arrays in pythonusing NumPy.
3. To understand DataFrame object for efficient storage and manipulation of labelled / columnar data inpython using Pandas.
4. To perform data visualizations in python using Matplotlib.
5. To practice machine learning algorithms in python using Scikit-Learn.

COURSE OUTCOMES:

1. Apply advanced IPython features including shell commands, magic commands, and debuggingtechniques.
2. Analyze NumPy functionalities such as data types, arrays, and computations, and implement them indata manipulation tasks.
3. Evaluate Pandas capabilities for data manipulation, aggregation, and grouping, and apply them to real-world datasets.
4. Create visualizations using Matplotlib, customize plots, and interpret various types of plots for effectivedata communication.
5. Implement machine learning algorithms using Scikit-Learn, validate models, and apply them to real-world problems.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	2	2	2	2	2	2	3
CO2	3	2	2	2	3	2	2	2	2	2	2	3
CO3	3	2	2	2	3	3	2	2	2	2	2	3
CO4	3	3	3	3	3	3	2	2	2	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2	2	3

UNIT-I

Ipython: Beyond Normal Python

Shell and Notebook, Help and Documentation in IPython, Keyboard Shortcuts in the IPython Shell, IPython Magic Commands, Input and Output History, IPython and Shell Commands, Errors and Debugging Profiling and Timing Code.

UNIT-II

Introduction To Numpy

Understanding Data Types in Python, The Basics of NumPy Arrays, Computation on NumPy Arrays: UniversalFunctions, Aggregations, Computation on Arrays, Comparisons, Masks, and Boolean Logic, Fancy Indexing, Sorting Arrays, Structured Data.

UNIT-III

Data Manipulation with Pandas

Installing and Using Pandas, Introducing Pandas Objects, Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance Pandas.

UNIT-IV

Visualization with Matplotlib

General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors, Density and Contour Plots,Histograms, Binnings, and Density, Customizing Plot Legends, Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks, Customizing Matplotlib, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap, Visualization with Seaborn.

UNIT-V

Machine Learning with Scikit-Learn

Machine Learning- Introducing Scikit-Learn, Hyperparameters and Model Validation, Feature Engineering, Naive Bayes Classification, Linear Regression, Support Vector Machines, Decision Trees and Random Forests, Principal Component Analysis, k-Means Clustering, Gaussian Mixture Models, Application: A Face Detection Pipeline.

TEXT BOOKS:

1. Jake VanderPlas, ―Python Data Science Handbook: Essential Tools for Working with Data‖,O'Reilly, 2017.

SUGGESTED READING:

1. Wes McKinney, ―Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython‖,O'Reilly, 2nd Edition,2018.
2. Python for data science for dummies 2nd Edition, John Paul Mueller, Luca Massaron, Wiley

22ADO03

FREE AND OPEN SOURCE SOFTWARE

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: THIS COURSE AIMS TO

1. To be exposed to the context and operation of free and open sourcesoftware (FOSS) communities and associated software projects
2. To be familiar with participating in a FOSS project
3. To get acquaintance of Programming Tools and Techniques
4. To learn the language Perl
5. To Learn Open Source Software Development

COURSE OUTCOMES:

1. Differentiate between various open-source software licensing models, including Free Software Movementand Open-Source Movement.
2. Demonstrate proficiency in Linux installation, including configuring hardware and managing the bootprocess using tools like LILO and GRUB.
3. Create and execute Bash shell scripts, manipulate variables and input, and utilize control structureseffectively.
4. Assess and select appropriate design tools like Argo UML, version control systems.
5. Configure and manage MySQL servers, work with MySQL databases and tables

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	3	2	2	2	1	1	2	2
CO2	3	-	-	-	3	2	2	2	1	1	2	2
CO3	3	1	2	2	3	2	2	2	2	2	2	2
CO4	3	1	1	2	3	2	2	2	2	2	2	2
CO5	3	1	2	2	3	2	2	2	2	2	2	2

UNIT-I

OPEN-SOURCE SOFTWARE OVERVIEW

Introduction, Need and Advantage of Open-Source Software, FOSS, Free Software Movement, Open-Source Movement, Open Source Licensing Certification, OSS Development Model, Run a Free Software Project, Comparing OSS with other Software-OSS Licenses

UNIT IILINUX

Linux Installation and Hardware Configuration, Boot Process-The Linux Loader (LILO), The Grand Unified Bootloader (GRUB), Dual-Booting Linux and other Operating System Options, X Windows System Configuration, System Administration, Backup and Restore Procedures, Strategies for Keeping a Secure Server.

UNIT-III
SHELL PROGRAMMING
Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Handling signals, creating functions, working sed and gawk, working with web using shell script: Downloading web page,Converting Web page content to a text file, parsing data, working cURL.

UNIT-IV
PROGRAMMING TOOLS AND TECHNIQUES
Usage of Design Tools Like Argo UML or Equivalent - Version Control Systems Like Git or Equivalent – Bug Tracking Systems- Package Management Systems.

UNIT-V
OPEN SOURCE DATABASE AND APPLICATIONS
MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. PHP – MySQL Application Development: Connecting to MySQL with PHP, Inserting data with PHP, Retrieving data with PHP.

TEXT BOOKS:

1. Prof. Dayan and Ambawade, Deven Shah, "Linux Labs And Open Source Technologies" , Dream TechPress, 2014.
2. Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley and Dan Mackin , "UNIX and Linux System Administration Handbook ", 5th Edition, Addison-Wesley Professional, 2017.
3. Julie C Meloni, "PHP, MySQL and Apache", Sixth Edition, Pearson Education, 2017.

SUGGESTED READING:

1. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in aNutshell", Sixth Edition,OReilly Media, 2009.
2. Tom Phoenix, Randal Schwartz, Brian Foy "Learning Perl" , 6th Edition,O'Reilly Media, 2011.
3. Wale Soyinka, Linux Administration- A beginner's Guide, Tata McGraw Hills, 2012
4. Fadi P. Deek and James A. M. McHugh, Open Source Technology and Policy, Cambridge UniversityPress, 2007
5. Andrew M. St. Laurent, "Understanding Open Source and Free Software Licensing", O'Reilly Media,2004.
6. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, "Linux in a Nutshell", Sixth Edition,Oreilly Media, 2009

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF CET

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	22CIO01	Fundamentals of IoT
2.	22CIO02	Basics of Cyber Security
3.	22CIO03	Fundamentals of Blockchain Technology
4.	22CIO04	Fundamentals of AR &VR

22CIO01

Fundamentals of IoT

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-Requisites

Programming Basics, Computer Architecture and Micro Processor.

Course Objectives

1. Impart necessary and practical knowledge of components in Internet of Things.
2. Understand working of IoT Systems.
3. Develop skills required to build IoT based systems.

Course Outcomes

By the end of this course, students should be able to:

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Classify various sensing devices and actuator types.
3. Understand the Associated IOT Technologies.
4. Develop the IoT application using the different board.
5. Understand and apply various protocols for design of IoT systems.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	1	1	1	1	-	-	-	-	-	-	1
CO2	1	1	-	1	-	-	-	-	-	-	-	2
CO3	1	1	-	1	2	-	-	-	-	-	-	1
CO4	2	2	1	1	1	1	1	-	1	1	-	2
CO5	2	2	1	1	1	-	-	-	-	-	-	2

Unit – I

Introduction to IoT: IoT Definition, IoT Characteristics, IoT Applications, Key Components of IoT System Things/Device, Gateway, Cloud/Server, Analytics, User Interface, Architecture of IoT.

IoT Challenges: Design Challenges, Security Challenges.

Unit – II

Machine-to-Machine Communications, Difference between IoT and M2M.

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

Associated IoT technologies: Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Sensor-Cloud: Sensors-as-a-Service.

Unit – III

Programming with Arduino Uno: ARDUINO UNO board Block diagram, Sketch Structure, Data types & Built in Constants, Operators: Arithmetic, Bitwise, Compound, Comparison, and Boolean, Control statements and Loops, Functions and library functions, LED Blinking using Arduino, Serial Communication Functions, Introduction to Raspberry Pi Programming, Sample Implementation of IoT with Raspberry Pi

Unit – IV

IoT Protocols: MQTT, CoAP, XMPP, AMQP, Bluetooth Low Energy (BLE), ZigBee, Z-Wave, RPL.

Unit – V

IoT Case Studies And Future Trends:

Vehicular IoT – Introduction, Healthcare IoT – Introduction, Case Studies, IoT Analytics – Introduction Smart City-Smart Lighting, Smart Parking Environment, Agricultural IoT – Introduction and Case Studies.

Textbook:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, “Introduction to IoT”, Cambridge University Press 2021.
2. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.

Reference Books

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Web Reference

1. https://onlinecourses.nptel.ac.in/noc24_cs35/preview
2. https://www.nabto.com/guide-iot-protocols-standards/

22CIO03

Fundamentals of Blockchain Technology

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Pre-Requisites

Course Objectives

1. To provide an understanding of blockchain benefits and limitations
2. To familiarize with decentralisation and cryptography
3. To explore theoretical foundations of bitcoin
4. To equip with the knowledge of smart contracts
5. To analyse real-world case studies and applications of blockchain technology across various industries.

Course Outcomes

By the end of this course, students should be able to:

1. Explain the fundamental concepts and principles of blockchain technology.
2. Describe the decentralisation and cryptographic primitives.
3. Understand bitcoin and its limitations
4. Analyse smart contracts and Ethereum blockchain
5. Evaluate the potential applications and impact of blockchain technology in different sectors.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	3	1	-	-	-	-	-	-	3
CO2	3	3	3	3	1	-	-	-	-	-	-	3
CO3	3	3	3	3	2	-	-	-	-	-	-	3
CO4	3	3	3	3	2	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3

Unit – I

Introduction to Blockchain Technology

Blockchain 101: Distributed systems, History of blockchain, Introduction to blockchain, Types of lockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

Unit – II

Decentralization and Cryptography:

Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys

Unit – III

Bitcoin and Alternative Coins:

Bitcoin, Transactions, Blockchain, Bitcoin payments Alternative Coins. Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Unit – IV

Smart Contracts and Ethereum 101:

Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

Unit – V

Alternative Blockchains: Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media. **Case studies and real-world projects showcasing blockchain technology in various industries.**

Textbook:

1. Imran Bashir, "Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained", Packt Publishing Ltd, Second Edition, 2018
2. Imran Bashir, "Mastering Blockchain - A technical reference guide to the inner workings of blockchain, from cryptography to DeFi and NFTs", Packt Publishing Ltd, Fourth Edition, 2023

Reference Books

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction"
2. Daniel Drescher, " Blockchain Basics: A Non-Technical Introduction in 25 Steps", Apress, First Edition, 2017.

Web Reference

1. https://nptel.ac.in/courses/106/104/106104220/
2. https://nptel.ac.in/courses/106/105/106105184/

22CIO02

Basics of Cyber Security

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Pre-Requisites
Basic knowledge on computer hardware and software components.

Course Objectives
1. To describe the foundational concepts of cybersecurity, including the CIA triad (Confidentiality, Integrity, Availability), and explain their importance in information security practices.
2. To demonstrate understanding of various cyber offenses by explaining the methods used by criminals to plan and execute cyber-attacks.
3. To understand the legal perspective of Cyber Security.
4. To collect, process, analyse and present Computer Forensics Evidence.
5. To understand organizational implications of Cyber Security.

Course Outcomes
By the end of this course, students should be able to:
1. Demonstrate an understanding of cybersecurity by effectively analysing and evaluating the security implications of various scenarios.
2. Identify and describe different types of cyber offenses, understand the techniques used by cybercriminals, and analyse the potential impact of these attacks on individuals, organizations, and society.
3. Analyse and evaluate the legal framework of cyber laws in India.
4. Analyse the significance of digital evidence in cyber forensics.
5. Evaluate the organizational implications of cyber security by assessing the costs associated with cybercrimes.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	2	2	3	1	3	3	3	2	3
CO 2	2	3	2	2	3	3	1	3	3	3	2	3
CO 3	1	2	2	2	1	3	1	3	2	3	3	3
CO 4	2	2	2	2	3	3	1	3	3	3	3	3
CO 5	2	2	2	2	2	3	1	3	3	3	3	3

Unit – I
Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cybercrime and Information Security, Classification of Cyber Crimes.
Cyber Security Fundamentals: Definition and importance of cybersecurity, CIA triad: Confidentiality, Integrity, Availability, Security design principles: defence-in-depth, least privilege, separation of duties.

Unit – II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Password Managers, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

Unit – III

Cyber Laws: The Legal Perspectives, Need of Cyber laws: the Indian Context, The Indian IT Act, Amendments of Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India.

Unit – IV

Understanding Cyber Forensics: Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

Unit – V

Cyber Security Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations.

Capstone Project: Group project: analyse a real-world cyber-attack, develop a mitigation strategy, and present findings to the class.

Textbook:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. William Stallings," Cryptography and Network Security - Principles and Practice", Pearson Education, 6th Edition,2013.
3. Whitman, M., & Mattord, H."Principles of information security" (6th ed.). CENGAGE Learning Custom Publishing, 2017.

Reference Books

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback – 2018.
2. Kevin Mandia, Chris Prosise, "Incident Response and computer forensics", Tata McGraw Hill, 2006.

Web Reference

1. https://www.coursera.org/courses?query=cybersecurity&productDifficultyLevel=Beginner
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

22CIO04

Fundamentals of AR & VR

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Pre-Requisites

Basic knowledge on computer hardware and software components.

Course Objectives

1. Learn a ton about virtual and augmented reality; get familiar with the latest technology and software,
2. Virtual reality in different object & applications
3. To understand key elements of virtual Reality with the components in VR systems.
4. To gain knowledge of various input and output devices required for interacting in virtual world along with rendering and modelling.

Course Outcomes

By the end of this course, students should be able to:

1. Understand the components of the virtual reality system.
2. Describe various input and output devices used for virtual reality.
3. Apply the different modelling concepts to visual virtualization.
4. Understand the concepts of the augmented reality system.
5. Analyse the performance of given simple applications related to virtual reality.

CO-PO Articulation Matrix

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	3	1	-	-	-	-	-	-	3
CO2	3	3	3	3	2	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3

Unit – I

Introduction to Augmented and Virtual Reality-: AR- VR, Understanding Virtual Space- Defining Visual Space and Content- Defining Position and Orientation in Three Dimensions- Navigation. **The Understanding the Human Senses and Their Relationship to Output/Input Devices**- - The Mechanics of Sight - The Visual Pathway - Spatial Vision and Depth Cues.

Unit – II

Component Technologies of Head-Mounted Displays- Display Fundamentals- Related Terminology and Concepts- Optical Architectures. Augmenting Displays- Binocular Augmenting Displays- Monocular Augmenting Displays. **Fully Immersive Displays** - PC-Console Driven Displays- Smartphone-Based Displays- CAVES and Walls -Hemispheres and Domes

Unit – III

The Mechanics of Hearing: -Defining Sound -The Auditory Pathway-Sound Cues and 3D Localization-The Vestibular System**. Audio Displays**-Conventional Audio- The Mechanics of Feeling- The Science of Feeling -Anatomy and Composition of the Skin.

Unit – IV

Tactile and Force Feedback Devices: -Haptic Illusions -Tactile Feedback Devices- Force Feedback Devices-Sensors for Tracking Position, Orientation, and Motion -Introduction to Sensor Technologies- Optical Trackers - Beacon Trackers - Electromagnetic Trackers - Inertial Sensors- Acoustic Sensors. **Devices to Enable Navigation and Interaction**: -2D Versus 3D Interaction and Navigation -The Importance of a Manual Interface - Hand and Gesture Tracking Gloves- Whole Body Tracking - Gaming and Entertainment Interfaces.

Unit – V

Applications of Augmented and Virtual Reality: Gaming and Entertainment - Virtual Reality and the Arts-Immersive Video/Cinematic Virtual Reality- Health and Medicine -Advancing the Field of Medicine- Training Applications- Treatment Applications. **Aerospace and Défense**:- Flight Simulation and Training- Mission Planning and Rehearsal- Dismounted Soldier Situational Awareness- Advanced Cockpit Avionics- Space Operations. Education - Tangible Skills Education- Theory, Knowledge Acquisition, and Concept Formation.

Textbook:

1. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, by Steve Aukstakalnis, Released September 2016, Publisher(s): Addison-Wesley Professional, ISBN: 9780134094328

Reference Books

1. Augmented Reality: Principles and Practice" by Dieter Schmalstieg and Tobias Hollerer (2021)
2. Virtual Reality: Concepts and Technologies" by Philippe Fuchs, Pascal Guitton, and Eric Marchand (2021)
3. Virtual Reality: Concepts, Methodologies, Tools, and Applications" edited by Information Resources Management Association (2023)
4. Handbook of Augmented Reality and Virtual Reality" edited by Leila Alem and Christoph Bartneck (2024)

Web Reference

1.Unity Learn
2. Coursera
3. Udemy
4. YouTube

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY, HYDERABAD – 075

DEPARTMENT OF CIVIL ENGINEERING

OPEN ELECTIVES (R22 & R22 (A))

(Offered by Civil Engg. Department to other Departments)

Sl. No.	Code	Subject Name	Semester
1	22CE O01	Infrastructure for Smart Cities	Even semester
2	22CE O02	Disaster Risk Reduction and Management	Odd semester
3	22CE O03	Green Buildings for Sustainable Infrastructure	Odd semester
4	22CE O04	Project Planning and Management	Even semester
5	22CE O05	Intelligent Transportation Systems	Odd semester
6	22CE O06	Environmental Pollution Management	Even semester

22CEO01

INFRASTRUCTURE FOR SMART CITIES

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Understand the necessity of infrastructural development for smart cities.
2. Illustrate the components and planning aspects of a smart city.
3. Outline smart transportation systems for smart cities.
4. Summarise the significance of disaster resilient infrastructure in smart cities.
5. Review policies and implementation of smart cities at national and global perspective.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	2	-	-	-	-	1	-	-	-	-	-	-
CO3	2	-	-	-	3	1	-	-	-	-	-	-
CO4	2	3	-	-	3	1	-	-	-	-	-	-
CO5	2	-	-	-	-	1	-	-	-	-	3	-

UNIT I

Fundamental of smart city & Infrastructure: Introduction of Smart City, Concept of smart city, Objective for smart cities. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment

UNIT II

Planning and development of Smart city Infrastructure: Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security.

UNIT III

Intelligent transport systems: Connected vehicles, autonomous vehicles, GPS, Navigation system, traffic safety management, mobility services, E-ticketing.

UNIT IV

Disaster resilient Infrastructure: Electricity, sanitation and water supply systems, fire hazard management, earthquake resilient structures, ICT tools.

UNIT V

Infrastructure Management: System and Policy for Smart city, integrated infrastructure management systems, worldwide policies for smart city, Government of India - policy for smart city, Smart cities in India, Case studies of smart cities.

Text Books:

1. John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); “Remaking the city: Social science perspective on urban design”; State University of New York Press, Albany (ISBN: 0-87395-678-8)
2. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science

References:

1. Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers (2007). "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science.
2. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines(1).pdf
3. Grig N.S., Infrastructure engineering and management, Wiley-Interseience, 1988 5. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ar12/preview
2. http://acl.digimat.in/nptel/courses/video/105105160/L01.html

22CEO02

DISASTER RISK REDUCTION AND MANAGEMENT

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Explain the fundamental concepts of disaster management.
2. Demonstrate the principles and practices of disaster risk reduction management.
3. Identify stress and its management during disaster.
4. Outline institutional frame work at different levels of administration.
5. Evaluate disaster management study including data search, analysis and presentation as a case study.

CO-PO Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	2	3	-	-	-	-	1
CO2	2	-	-	-	-	2	3	-	-	-	-	1
CO3	2	-	-	-	-	2	3	-	-	-	-	1
CO4	2	-	-	-	2	2	3	-	-	-	-	1
CO5	2	-	-	-	-	2	3	-	-	-	-	1

UNIT I

Fundamental concepts in disaster management: Hazard and disaster-concepts, vulnerability and risk, Hazardand disaster type – Natural, Water- related, pandemic and Human induced hazards disasters. Causes and Impactsof disasters – Impacts on natural eco systems: physical, psychological and social impact. Disaster and financial resilience. Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance)

UNIT II

Disaster Management Cycle: Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness. Disaster risk reduction (DRR). Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards and Early warning systems

UNIT III

Disaster Impacts Management: Trauma and stress management, First aid and emergency procedures Awareness generation strategies for the community on safe practices in disaster (as per regional significance)

UNIT IV

Institutional framework of disaster management in India: NDMA-SDMA, NDRF, civic volunteers, and NIDM. Phases of disaster/risk management and post-disaster responses. Compensation and insurance Applications of remote sensing & GIS in disaster management. Components of disaster management. Preparedness of rescue and relief, mitigation, rehabilitation & reconstruction. Institutional frame work of disaster management in India

UNIT V

Capacity building for disaster/damage mitigation: Structural and Nonstructural measures forcapacity building for disaster/damage mitigation. Disaster risk reduction strategies and national disaster management guidelines. Disaster management Act -2005. Regional issues as per regional requirement/university can take minimum two topics as per high powered committee

Text Books:

1. Singh, R. (2017), "Disaster management Guidelines for Earth quakes, Landslides, Avalanches andTsunami". Horizon Press publications.
2. Taimpo (2016), "Disaster management and preparedness". CRC Press Publications

Suggested Reading:

1. Nidhi, G.D. (2014), "Disaster management preparedness" .CBS Publications Pvt. Ltd.
2. Gupta, A.K.,Nair, S.S., Shiraz, A. and Dey, S. (2013), "Flood Disaster Risk Management-CBS Publications Pvt Ltd.
3. Singh, R. (2016), "Disaster management Guidelines for Natural Disasters" Oxford University PressPvt. Ltd

E Resources:

1. https://nptel.ac.in/courses/124107010
2. https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

22CEO03

GREEN BUILDINGS FOR SUSTAINABILE INFRASTRUCTURE

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Identify green building and green building materials.
2. Make use of different rating agencies to classify the type of building.
3. Analyze sustainability and its implications for the practice of engineering.
4. Evaluate the potential of the alternative construction materials for sustainability.
5. Examine the green building rating systems and its contribution to sustainability.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	1	1	3	-	-	-	-	-
CO2	2	-	-	-	-	1	3	-	-	-	-	-
CO3	2	-	-	-	1	1	3	-	-	-	-	-
CO4	2	-	-	-	-	1	3	-	-	-	-	-
CO5	2	-	-	-	1	1	3	-	-	-	-	-

UNIT-I

Course Syllabus Green Building: Concept of Green building, Principles of green buildings, Eco-friendly materials, Certification systems – Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED).

UNIT-II

Green Building Materials: Green Building Materials and Equipment in India, what are key requisites for Constructing a Green Building, Important Sustainable features for Green Building.

UNIT-III

Building Services: Fire protection – classes of fire and causes, development of fire, fire resisting materials, means of escape, Standing Fire Advisory Council norms. Water supply -Water distribution and plumbing fixtures.

Applications in the Built Environment: Concepts of green buildings, climate responsive building - Reduction of energy consumption, direct and indirect methods - Reduction of water consumption, direct and indirect methods - Carbon footprint and eco footprints of buildings - New concepts and trends in green buildings, national and international.

UNIT-IV

Sustainability: The Concept of Sustainability; Definition of Sustainability, Dimension of Sustainability. Three Pillars of Sustainability, Principles of Sustainability - 5R, Construction Materials Resource Efficiency, Operational Reuses of the Construction Materials, Sustainability Goals for construction Industry.

UNIT-V

Sustainability in Built Environment: Environmentally sensitive design, low impact development, green infrastructure and conservation design, Green buildings and land use planning, Energy use and buildings.

Books and Materials Text Books:

1. Frederick S. Merritt, Jonathan T. Ricketts, Building design and construction Handbook, McGraw-Hill Inc., 5th edition, 1994.
2. Fred hall and Roger Greeno, Building Services Handbook, Routledge, 7th edition, 2013.

Reference Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Bradley A. Striebig, Adebayo A. Ogundipe and Maria Papadakis, Engineering Applications in Sustainable Design and Development, 1st edition, 2016.
3. Handbook on Green Practices published by Indian Society of Heating Refrigerating and

Air conditioning Engineers, 2009.

E Resources:

1. https://archive.nptel.ac.in/courses/105/102/105102195/
2. https://archive.nptel.ac.in/courses/124/107/124107011/

22CEO04

PROJECT PLANNING AND MANAGEMENT

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Course Outcomes (COs)

1. After the completion of the course, the student will be able to:
2. Identify project characteristics and various phases of a project.
3. Illustrate project organization, staffing and feasibility of projects.
4. Apply the techniques of Project planning, scheduling and Execution Control.
5. Evaluate Resources, Budget, Claims and Disputes.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-		-	2	-	-	3	-
CO2	2	3	-	-	-		-	-	-	-	3	-
CO3	2	3	-	-	-		-	-	-	-	3	-
CO4	2	2	-	-	-	3	-	-	-	-	3	2
CO5	2	2	-	-	-	3	-	2	-	-	3	2

UNIT-I

Project Management: Overview of Project Management, Concepts and Definitions. Project manager and his responsibilities. Types of projects, various stages of projects, Organizational structures used in project management. Management Functions and staffing.

UNIT-II

Project Planning: Time planning, Contents of Project plan, planning process, Work breakdown structure, process mapping. Project Budgeting: Financial Projections, time value of money, cost of capital, capital investment decisions.

UNIT-III

Scheduling Techniques: Bar Charts, CPM & PERT: Time estimate- Optimistic time estimate, Most likely time estimate, Pessimistic time estimate & Expected time. Project Scheduling, Network Analysis, Cost- Time Analysis in Network Planning, Float - Total float, free float.

UNIT-IV

Monitoring and Controlling: Plan monitor control cycle, data collection and reporting, Project control.Working with stakeholders.

UNIT-V

Conflict Management: claims and Disputes- Source of claim, Claim Management, Dispute resolution,Arbitration and its advantages, Project closure.

Text Books:

1. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015.
2. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Reference Books:

1. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
2. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006.
3. Angerame, Mike. Engineering & construction project management. Denver, Colo: Hampton Group, 2002.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/104/105104161/
2. https://archive.nptel.ac.in/courses/110/104/110104073/

22CEO05

INTELLIGENT TRANSPORTATION SYSTEMS

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Outline the fundamental components of ITS.
2. Demonstrate the ability to identify various data collection techniques used in ITS.
3. Understand the telecommunications and information management in ITS.
4. Gain in-depth knowledge of the functional areas within ITS.
5. Evaluate the different user needs and services provided by ITS.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	1	3	-	-	-	-	-
CO2	2	2	-	-	-	1	3	-	-	-	-	-
CO3	2	2	-	-	-	1	3	-	-	-	-	-
CO4	2	2	-	-	-	1	3	-	-	-	-	-
CO5	2	-	-	-	-	1	3	-	-	-	-	-

UNIT I

Introduction to ITS: Definition of ITS and identification of ITS objectives, objectives and goals of ITS, historical background, evolution and development of ITS, benefits of ITS, economic, environmental, and social benefits.

UNIT II

ITS Data Collection Techniques: Detectors, types of detectors and their applications; Automatic Vehicle Location (AVL), technology and usage; Automatic Vehicle Identification (AVI), systems and implementation; Geographic Information Systems (GIS), role in ITS; video data collection, techniques and importance.

UNIT III

Telecommunications in ITS: Importance of telecommunications in the ITS system, role and necessity of telecommunications, information management, data collection, storage, and dissemination; Traffic Management Centres (TMC), functions and operations; vehicle – roadside communication, methods and technologies; vehicle positioning system, GPS and other positioning technologies.

UNIT IV

ITS Functional Areas: Advanced Traffic Management Systems (ATMS) concepts and components; Advanced Traveler Information Systems (ATIS), features and benefits; Commercial Vehicle Operations (CVO) systems and management; Advanced Vehicle Control Systems (AVCS), safety and control mechanisms; Advanced Public Transportation Systems (APTS), enhancing public transport efficiency; Advanced Rural Transportation Systems (ARTS), ITS applications in rural areas.

UNIT V

ITS Applications and Global Perspective: ITS user needs and services, travel and traffic management, public transportation management, electronic payment systems, commercial vehicle operations, emergency management, advanced vehicle safety systems, information management, automated highway systems, concepts of vehicles in platoons, integration of automated highway systems, ITS programs in the world, overview of ITS implementations in developed countries, ITS in developing countries.

Textbooks:

1. Ghosh, S., Lee, T.S. Intelligent Transportation Systems: New Principles and Architectures, CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

Reference Books:

1. Karl B. Schnelle, Jr. and Charles A. Brown, Air Pollution Control Technology Handbook, CRC Press, 1st Edition, 2001.
2. Air Pollution by Jeremy Colls, SPON Press, 2nd Edition, 2003.
3. Seinfeld, J.H., Pandis, S.N., Atmospheric Chemistry and Physics, John Wiley, 2006.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ce14/preview
2. https://www.nptelvideos.com/video.php?id=1944&c=11

22CEO06

ENVIRONMENTAL POLLUTION MANAGEMENT

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Identify water pollution sources, types and treatment methods.
2. Apply knowledge on Prevention and control of air pollution.
3. Inspect sources, effects and mitigation methods of noise pollution.
4. Examine soil pollution sources, effects and control measures.
5. Develop Environmental management plan to minimize environmental pollution.

CO-PO Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	1	3	-	-	-	-	-
CO2	2	2	1	-	-	1	3	-	-	-	-	-
CO3	2	2	1	-	-	1	3	-	-	-	-	-
CO4	2	2	-	-	-	1	3	-	-	-	-	-
CO5	2	-	-	-	-	1	3	-	-	-	-	-

UNIT-I:

Water pollution: Introduction - Sources and types of water pollutants; Physical, Chemical and Biological properties; Ground water - Surface water – seawater, Estuaries. Impacts of water pollution on environment; Water Quality standards (Drinking and Industrial): IS code, CPCB, EPA and WHO - water treatment - physical, chemical and biological. Water Pollution Prevention and Control Act, 1974.

UNIT-II

Air pollution: Structure and composition of atmosphere – classification, sources and effects of air pollution; Environmental issues: Acid rain, global warming and ozone depletion, Air Quality Standards: CPCB, EPA and WHO, Air Quality Index (AQI), Prevention and control of air pollution particulate control – settling chamber, scrubber, bag filter, cyclones electrostatic precipitators. Gaseous emission control methods. Air pollution prevention and control Act 1981.

UNIT-III

Noise Pollution: Noise Pollution Basics of acoustics- propagation of indoor and outdoor sound- noise profiling effects of noise – measurement, index and mitigation methods- health effects of noise. Noise Standards: CPCB and WHO. Noise barrier design.

UNIT-IV

Soil Pollution: Sources, soil mineralogy, organic and inorganic pollutants - types and effects of pollutants on plants, soil pollution control measures - soil microbes and function, bioremediation.

UNIT-V

Environmental management: Environmental impact assessment and statement; Government strategies in pollution control: subsides, polluter pays principle and regulations; Sources of environmental information and regulations; Sustainable development and environmental protection.

Text Books:

1. C. S. Rao, Environmental Pollution Control Engineering, 3rd Edition, New Age International Pvt Ltd, 2018.
2. Rao, M. N and H.V.N. Rao, Air Pollution, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2017.

Reference Books:

1. H.S Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, Indian Edition, McGraw Hill Education (India) Pvt Ltd, 2014.
2. De Nevers, N., Air Pollution Control Engineering, 3rd edition, Waveland Press Inc 2017.
3. Sagar Pal Singal , Noise Pollution and Control Strategy, 2nd Edition, Alpha Science International Ltd,2005.

E Resources:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://archive.nptel.ac.in/courses/103/107/103107215/

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ECE

List of Open Elective Courses offered by ECE Dept. to other departments UG Programs R-22 & R-22(A) Regulation with effect from AY 2024-25

S.no.	Course Code	Course Name
1	22ECO01	System Automation & Control
2	22ECO02	Remote Sensing and GIS
3	22ECO03	Fundamentals of Wireless Communications
4	22ECO04	Basics of Digital Signal Processing
5	22ECO05	Principles of Embedded Systems
6	22ECO06	Principles of VLSI
7	22ECO07	Neural Networks And Fuzzy Logic

22ECO01

SYSTEM AUTOMATION AND CONTROL

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about physical parameters in industry is required

COURSE OBJECTIVES: This course aims to

1. Learn the concepts industrial control systems
2. Learn how to measure the physical parameters in industry
3. Learn the applications of Robots in industry.

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

1. Understand the features of various automatic and process control systems.
2. Define and analyze various measuring parameters in the industry.
3. Compare performance of various controllers (P, PD, PI, and PID).
4. Illustrate the role of digital computers in automation.
5. Develop various robot structures for different applications.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	3	2	2	1	-	-	1	-	-	2
CO 2	3	3	3	2	1	1	-	-	1	-	-	1
CO 3	3	3	3	3	2	1	-	-	1	-	-	2
CO 4	2	2	2	2	2	2	-	-	1	-	-	2
CO 5	3	3	3	3	2	2	-	-	2	-	-	1

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.

Sensors: Sensor definition, Different types of Sensors:Motion, Position, Force, Level sensors, and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.

Measurement Techniques and Hardware: Typical Sensor outputs, Bridge measurements: General equation for bridge balance, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, Analog and Digital methods of Control.

Controller Hardware: Analog and Digital Controllers, Pneumatic controllers, Integral, derivative, PI,PD,PID controllers.

UNIT-IV

Digital Computers as Process Controllers: Introduction, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.

Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications. Trouble shooting System failures: Preliminary steps and other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested Reading:

1. Kuo B. C, "Automatic Control Systems", 9th edition
2. A.K Sawhney,"A course on Electrical and Electronic Measurements and Instrumentation".

22ECO02

REMOTE SENSING AND GIS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Geography is required

COURSE OBJECTIVES: This course aims to

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

1. Demonstrate the understanding of basic concepts of remote sensing and interpreting energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	1	1	-	1	1	1	-	1	-	2
CO 2	3	1	1	1	-	1	1	1	-	1	-	2
CO 3	3	1	1	1	-	1	1	1	-	1	-	2
CO 4	2	1	1	1	-	1	1	1	-	1	-	2
CO 5	3	1	1	1	-	1	1	1	-	1	-	2

UNIT-I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages, and limitations of Remote sensing.

UNIT-II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT-III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT-IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

22ECO03

FUNDAMENTALS OF WIRELESS COMMUNICATIONS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on basics of electronics is required.

COURSE OBJECTIVES: This course aims to

1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes applied in wireless communication and understand the latest Wireless technologies

Course Outcomes:

1. Understand the overview of Wireless Communication.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyse the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity technique to combat the multipath fading effects.
5. Compare the multiple access techniques and apply to wireless standards.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	1	1	-	1	-	-	-	-	1
CO 2	2	1	1	2	1	-	1	-	-	-	-	1
CO 3	2	2	1	2	2	-	2	-	-	-	-	1
CO 4	2	1	1	1	1	1	1	-	-	2	-	2
CO 5	2	1	1	1	1	1	1	-	-	1	-	1

UNIT-I

An overview of wireless communications: Roadmap of cellular communications. First-Generation systems. Second-Generation systems. Third-Generation systems, Fourth-Generation systems and Fifth-Generation Systems.

UNIT-II

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Power Control for Reducing Interference.

UNIT-III

Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, the Three Basic Propagation Mechanisms, Small-Scale Fading and Multipath: Small-Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Types of Small-Scale Fading.

UNIT-IV

Diversity Techniques: Practical Space Diversity Considerations- Selection Diversity, Feedback or Scanning, Maximal Ratio Combining Diversity Equal Gain Combining. Orthogonal frequency division multiplexing: Introduction, Principle of OFDM. OFDM transceivers Cyclic prefix, Spectrum of OFDM, Fading mitigation in OFDM. Intercarrier interference.

UNIT-V

Multiple access techniques: Duplexing: FDD versus TDD. FDMA. TDMA. CDMA . OFDMA. SDMA

Wireless Standards: Global System for Mobile (GSM). GSM Services and Features, GSM System Architecture, GSM Radio Subsystem. GPRS and EDGE- features.

Text Books:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andreas F.Molisch - Wireless Communications John Wiley, 2nd Edition, 2006.
3. Ke-Lin Du, Concordia University, Montréal,M. N. S. Swamy- Wireless Communication Systems.From RF Subsystems to 4G Enabling Technologies. April 2010

Reference Books:

1. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.

22ECO04

BASICS OF DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic concepts of signals are required.

COURSE OBJECTIVES: This course aims to

1. Learn the advantages of DSP over analog signal processing.
2. Analyze discrete-time signals in the frequency domain using DFT and FFT.
3. Learn the theory of digital filters.

Course Outcomes:

1. Understand the concept of Discrete time signals and systems
2. Analyze the frequency domain representation of discrete time sequence using DTFT and DFT.
3. Apply FFT to the given sequence.
4. Implementation of FIR filter for the given specifications
5. Design an IIR filter for the given specifications.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	3	2	-	-	2	2	-	2
CO 2	3	3	3	2	2	2	-	-	2	2	-	2
CO 3	3	3	3	2	3	2	-	-	2	2	-	2
CO 4	3	3	3	2	2	2	-	-	2	2	-	2
CO 5	3	3	3	2	3	2	-	-	2	2	-	2

UNIT-I

Discrete Time Signals and Systems: Introduction, basic elements of a digital signal processing system, advantages and disadvantages of Digital Signal Processing over Analog signal processing, sampling theorem, analog to digital and digital to analog conversion. Discrete-Time System: Mathematical representation of Discrete Time Systems, Concept of Impulse response, and Transfer function, Linear and Time invariant systems, Concept of causality and stability.

UNIT-II

Frequency Domain Analysis of Discrete Time Sequences: Discrete Time Fourier Transform (DTFT), properties of DTFT, Discrete Fourier Transform (DFT) and its properties, relationship between DFT to the DTFT, circular convolution.

UNIT-III

Fast Fourier Transform (FFT): Introduction, Radix-2 Decimation–In-Time FFT(DIT-FFT) and Decimation-In-Frequency FFT(DIF- FFT) algorithms, Bit reversal order, In-place computation.

UNIT-IV

FIR Filter Design: Introduction, Linear phase filters, Design of FIR (LPF, HPF, BPF and BSF) filters using Windows, Comparison between FIR and IIR filters.

UNIT-V

IIR Filter Design: Butterworth & Chebyshev approximations, Conversion from analog filters to digital filters using Impulse Invariance Method (IIM) and Bilinear Transformation (BLT) methods, prewarping. Realization of IIR filters- Direct form I & II, Realization of FIR filters-Direct from, linear phase.

Text Books:

1. Alan V. Oppenheim & Ronald W. Schafer, "Digital Signal Processing," PHI, 2/e, 2010.
2. John G. Proakis&Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application," PHI, 4/e, 2012.

Suggested Reading:

1. Sanjit K Mitra, " Digital Signal Processing", Tata Mc Graw Hill, Third edition, 2006.
2. ChiTsong Chen, "Digital Signal Processing", Indian edition, 2009.

22ECO05

PRINCIPLES OF EMBEDDED SYSTEMS

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about computer Architectures, Microprocessors and Microcontrollers.

COURSE OBJECTIVES: This course aims to

1. Learn the fundamentals of the embedded system design.
2. Learn architecture details of embedded processors
3. Analyze various embedded applications and debugging tools.

Course Outcomes:

1. Understand hardware and software details of embedded system.
2. Analyze the architecture and instruction set of embedded processors.
3. Develop the embedded system design cycle
4. Apply various debugging tools for embedded system applications.
5. Design different case studies for embedded applications.

Course Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	3	2	-	-	2	2	-	2
CO 2	3	3	3	2	2	2	-	-	2	2	-	2
CO 3	3	3	3	2	3	2	-	-	2	2	-	2
CO 4	3	3	3	2	2	2	-	-	2	2	-	2
CO 5	3	3	3	2	3	2	-	-	2	2	-	2

UNIT-I

Introduction to Embedded systems: Embedded systems vs General computing systems, Classifications, Applications areas, Processor embedded into a system, Processor selection for embedded system, Embedded hardware units and devices in a system, Design metrics and Challenges in embedded system design.

UNIT-II

Embedded Processors: PIC 18 Family Overview, Architecture, Instruction Set, Addressing modes, Timers and Interrupts of PIC 18. Capture/Compare and PWM modules of PIC 18.

UNIT-III

Introduction to advanced processor architectures: ARM design philosophy. ARM data flow model, Register organization, Program Status Register, Pipeline, Introduction to exceptions. ARM instruction set, Introduction ARM cortex series, salient features.

UNIT-IV

Embedded System Design Cycle: Embedded system design and co-design issues in system development process, Design cycle in the development phase for an embedded system. Embedded software development tools: Host and Target machines, Linker/Locators for embedded software, Embedded software into the target system.

UNIT-V

Debugging tools and Applications: Integration and testing of embedded hardware, testing methods, Debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, Simulator, Emulator and In-Circuit Emulator, IDE.

Case Studies: Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee).

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design," 3/e, Tata McGraw Hill Education, 2015.
2. Andrew N.SLOSS, DomonicSymes Chris Wright "ARM System Developers Guide-Designing and optimizing system software" ELSEVIER 1st Edition2004.
3. Mazidi, MCKinlay and Danny Causey, "PIC Microcontrollers and Embedded Systems", Pearson Education. 2008

Suggested Readings:

1. David E.Simon, "An Embedded software primer", Pearson Education,2004.
2. Steve Furber "ARM System on Chip Architecture" 2/e Pearson education, 2000.

22ECO06

PRINCIPLES OF VLSI

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic Electronics and Digital Logic Fundamentals are required.

COURSE OBJECTIVES: This course aims to

1. To study various characteristics of MOS transistor.
2. To learn various concepts required to obtain the digital logic layout diagrams.
3. To learn various memory design concepts.
4. To study various VLSI Fabrication process steps.

Course Outcomes: The student will be able to

1. Understand characteristic behavior of MOSFET
2. Describe various MOS layers and layout design rules.
3. Implement various CMOS logic circuits.
4. Design various MOS memories.
5. Understand the concepts of VLSI technology.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	3	2	-	-	2	2	-	2
CO 2	3	3	3	2	2	2	-	-	2	2	-	2
CO 3	3	3	3	2	3	2	-	-	2	2	-	2
CO 4	3	3	3	2	2	2	-	-	2	2	-	2
CO 5	3	3	3	2	3	2	-	-	2	2	-	2

UNIT – I

Introduction to MOS Technology: Basic MOS Transistor action. Enhancement and Depletion Modes. Basic electrical properties of MOS. Threshold voltage and Body Effect.

UNIT-II

MOS and CMOS circuit Design Process: N-Well, P-Well and Twin-Tub process. MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT – III

CMOS Design: Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

UNIT – IV

Memories: Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.

UNIT-V

Introduction to VLSI Technology and Fabrication Process: Introduction to microelectronics and moore's law, Various layers of IC, Wafer preparation and crystal growth, Oxidation, CVD, Lithography, Etching, Ion implantation, Diffusion techniques.

Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell, SholehEshraghian, “Essentials of VLSI circuits and systems”, PHI, 2011.
2. Neil H E Weste, David Harris, Ayan Banerjee “CMOC VLSI Design –A circuit and System Perspective”, 3/e, Pearson Education, 2006.
3. J.D.Plummer, M.D.Deal and P.B.Griffin, “The Silicon VLSI Technology Fundamentals”, Practice and modeling, Pearson Education 2009.

Suggested Reading:

1. John P. Uyemura, “Introduction to VLSI Circuits and systems”, John Wiley & Sons, 2011.
2. Simon Sze” VlSI Technology, 2/E”, McGraw-Hill Education (India) Pvt Limited-2003.

22ECO07

NEURAL NETWORKS AND FUZZY LOGIC

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge on fundamentals of computing.

COURSE OBJECTIVES: This course aims to

1. Study the learning strategies of artificial neural networks and their training algorithms.
2. Acquire knowledge about associate memory and training algorithms of various associate memory networks.
3. Study the fuzzy rule base system, decision making system, different methods of defuzzification and applications of fuzzy logic.

Course Outcomes:

1. To differentiate Biological system, intelligent systems and the concepts of crisp and fuzzy set theory
2. To analyze the learning strategies of Artificial Neural networks and learning rules
3. To understand training algorithms and are able to provide adequate knowledge about feed forward and feedback neural networks.
4. To design training algorithms for associative memory network for pattern recognition problems
5. To demonstrate knowledge and understanding of fuzzy system as they apply in real time systems and apply different methodologies to solve the problem related to the problem related to defuzzification.

Course Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	1	-	-	-	-	-	-	-
CO 2	3	3	2	2	2	-	-	-	-	-	-	-
CO 3	3	3	3	3	2	-	-	-	-	-	-	1
CO 4	3	3	3	2	3	-	2	-	-	-	-	2
CO 5	3	3	3	3	2	-	-	-	-	-	-	2

UNIT-I

Artificial Neural Networks:

Introduction, Biological Neuron, Artificial Neuron, Basic concepts of Neural Networks, Basic Models of ANN Connections, McCulloch-Pitts Model, Characteristics of ANN, Applications of ANN.

UNIT-II

Essentials of Artificial Neural Networks:

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity,
Learning, Strategies (Supervised, Unsupervised, Reinforcement), Learning Rules, Numerical problems, Types of Application

UNIT-III

Supervised Learning Networks:

Perceptron Network, Perceptron Learning Rule, Architecture, Perceptron Training Algorithm, ADALINE, MADALINE, Back Propagation Network, BP Learning Rule, Input Layer Computation, Hidden Layer Computation, Output Layer Computation, Radial Basis Function Demonstration through MATLAB- Introduction to Associate Memory Network

UNIT-IV

Classical & Fuzzy Sets:

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT-V

Fuzzy Logic System Components:

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods, Applications.

Text Books:

1. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publications.
3. Fundamental of Artificial Neural Network and Fuzzy Logic-by Rajesh Kumar, Lakshmi publications

Reference Books:

1. Neural Networks – James A Freeman and Davis Skapura, Pearson Education.
2. Neural Networks – Simon Hakins , Pearson Education

Suggested Videos:

1. https://onlinecourses.nptel.ac.in/noc21_ge07/preview#:~:text=This%20course%20will%20start%20with,help%20of%20some%20numerical%20examples.

Open Electives offered by EEE Department:

List of Open Elective Courses offered by EEE Department under R22 Regulation to other departmental students.

S.	Course code	Title of the course
1.	22EEO01	Energy Management System
2.	22EEO02	Energy Conservation
3.	22EEO03	Energy Resources, Economics and Environment
4.	22EEO04	Engineering Materials
5.	22EEO05	Energy Auditing
6	22EEO06	Waste Management
7	22EEO07	Fundamentals of Electric vehicles

22EEO01

ENERGY MANAGEMENT SYSTEM

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: None.

COURSE OBJECTIVES: This course aims to

1. Know the concept of Energy Management.
2. Understand the formulation of efficiency for various Engineering Systems
3. Enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding Energy Management

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Know the current Energy Scenario and importance of Energy Conservation.
2. Understand the concepts of Energy Management, Energy Auditing.
3. Interpret the Energy Management methodology, Energy security and Energy Strategy.
4. Identify the importance of Energy Efficiency for Engineers and explore the methods of improving Energy Efficiency in mechanical systems, Electrical Engineering systems
5. Illustrate the Energy Efficient Technologies in Civil and Chemical engineering systems

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	1	-	1	2	1	-	-	-	1
CO 2	2	1	1	1	-	1	2	1	-	-	-	1
CO 3	2	2	2	1	-	1	2	1	-	-	-	1
CO 4	2	2	1	2	2	1	2	1	-	-	-	1
CO 5	1	1	2	1	1	1	2	2	-	-	-	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Various forms of Energy and its features: Electricity generation methods using different energy sources such as Solar energy, wind energy, Bio-mass energy, and Chemical energy such as fuel cells. Energy Scenario in India, Impact of Energy on economy, development, and environment sectors of national and international perspective.

UNIT-II

Energy Management-I: Defining Energy Management, need for Energy Management, Energy management techniques, importance of Energy Management, managing the Energy consumption, Energy Audit and Types, Energy Audit Instruments.

UNIT-III

Energy Management-II: understanding Energy costs, bench marking, Energy performance, matching energy use to requirement, optimizing the input, fuel & Energy substitution, material and Energy balance diagrams, Energy pricing, Energy and Environment, Energy Security

UNIT-IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for Engineers, Energy Efficient Technology in Mechanical engineering: Compressed Air System, Heating, ventilation and air-conditioning, Fans and blowers, Pumps and Pumping Systems,

Energy Efficient Technology in Electrical engineering: Automatic Power Factor Controllers, Energy Efficient Motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, space cooling, energy efficiency of lifts and escalator, energy saving potential of each technology.

UNIT-V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Intelligent Buildings, And Various Energy Efficiency Rating Systems for Buildings, Green Buildings Energy Efficiency: management of green buildings, importance of embodied energy in selection of sustainable materials, green building design, waste reduction/recycling, rainwater harvesting, maintenance of the green buildings, green building certification, Renewable energy applications.

Energy Efficient Technology in Chemical Engineering: Green chemistry, Low carbon cements, recycling paper.

TEXT BOOKS:

1. Umesh Rathore, 'Energy Management', Kataria publications, 2nd ediiton, 2014.
2. G Hariharaiyer, “Green Building Fundamentals”, Notion press.com
3. K V Shama, P Venkataseshaiah, "Energy management and conservation", I. K. International Publishing agency pvt. ltd., 2011, ISBN: 978-93-81141-29-8

SUGGESTED READING:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
2. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland Universityof Technology.
3. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

22EEO02

ENERGY CONSERVATION
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: None

COURSE OBJECTIVES: This course aims to
1. Know the concept of Energy conservation
2. Understand the formulation of efficiency for various engineering systems
3. Explore the different ways to design various technologies for efficient engineering systems.

COURSE OUTCOMES: AFTER THE COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE After the completion of this course, the student will be able to
1. Know the current Energy Scenario and importance of Energy Conservation. [EC].
2. Understand the necessity of EC in domestic sector.
3. Comprehend the significance of EC in Industrial sector.
4. Explore the Energy Efficient Technologies in Mechanical and Civil Engineering domain.
5. Explore the Energy Efficient Technologies in Electrical and Chemical Engineering domain.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	2	-	2	-	-	-	-	-	-
CO 2	3	2		3	-	1	-	-	-	-	-	-
CO 3	3	3	2	3	2	2	-	-	-	-	-	-
CO 4	3	2	2	2	2	1	-	-	-	-	-	-
CO 5	2	2	1	2	2	1	-	-	-	-	-	-

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Basics of various Energy forms : Overview of Engineering elements , Solar energy, Electricity generation methods using Solar energy, PV cell, elements of wind energy, electricity generation using wind energy, sources of chemical energy, fuel cells; Hydrogen Cell , Energy Scenario in India.

UNIT-II

Energy Conservation-I: Domestic Sector: Energy conservation needs and objectives, Energy Conservation strategies in domestic sector, Energy Conservation tips in the kitchen, other energy saving tips in the domestic house, Energy Conservation measures in office, energy conservation processes/activities for a building. HVAC (heating, ventilation, air conditioning), components of HVAC, energy conservation opportunities in HVAC systems.

UNIT-III

Energy Conservation-II: Industrial Sector: Energy Conservation in Indian industrial sector, Energy saving potential in industry: boiler, furnaces, air compressors, refrigeration systems, heat exchanger, heat pump, turbines, electric drives, pumps, cooling towers, fans and blowers. Energy Conservation in agriculture sector: Energy Conservation opportunities in pumps used in agriculture sector**.**

UNIT-IV

Energy Efficient Technologies-I: Importance of Energy Efficiency for engineers**,**

Energy Efficient Technology in Mechanical Engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems. Energy

Efficient Technology in Civil Engineering: future of roads, harnessing road and transport infrastructure; Energy Efficient Technology in Agriculture: IoT and Drone Technology.

UNIT-V

Energy Efficient Technologies-II:

Energy Efficient Technology in Electrical Engineering: Electricity billing, Electrical load management and, power factor improvement and its benefit, selection and location of capacitors ;

Energy Efficient Technology in Chemical Engineering: green chemistry, low carbon cements, recycling paper. Green buildings concept, introduction to SCADA

TEXT BOOKS:

1. Umesh Rathore,'energy management', Katarina publications, 2nd edition, 2014.
2. G Harihara Ayer, “Green Building Fundamentals”, Notion press.com
3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGrawHill, 1991

SUGGESTED READING:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
2. Guidebooks for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects

ONLINE RESOURCES:

1. https://publicservice.vermont.gov/efficiency/energy-saving-resources
2. https://www.graygroupintl.com/blog/energy-conservation

22EEO03

ENERGY RESOURCES: ECONOMICS & ENVIRONMENT

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: None

COURSE OBJECTIVES: This course aims to

1. Impart the significance of non-conventional energy sources in the Indian and global energy mix, and analyze their potential contribution to energy security and sustainability
2. Disseminate the emerging technologies in the field of energy, including hydrogen energy systems, fuel cells, and biofuels, and assess their potential applications.
3. Provide the environmental aspects related to Electrical energy generation

COURSE OUTCOMES: AFTER THE COMPLETION OF THIS COURSE, THE STUDENT WILL BE ABLE After the completion of this course, the student will be able to

1. Know the various energy resources and its national and international scenario.
2. Understand the emerging technologies that prevail in energy sector.
3. Comprehend the impact of various generation methods on environment.
4. Understand impact of energy resource on global climate change.
5. Know the various economic evaluation strategies.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	-	2	-	2	-	-	-	-	-	-
CO 2	3	2		3	-	1	-	-	-	-	-	-
CO 3	3	3	2	3	2	2	-	-	-	-	-	-
CO 4	3	2	2	2	2	1	-	-	-	-	-	-
CO 5	2	2	1	2	2	1	-	-	-	-	-	-

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT – I

Energy Resources – National and Global Scenario: Electric energy from conventional source - Thermal plants (coal fuelled), Nuclear power- Nuclear fission, Nuclear fusion, Energy reserves of India- Coal, oil, Natural gas, Energy parameters- Energy intensity, Cogeneration, Indian and Global Energy Resources- Significance of Non-Conventional, Energy Policy in India, World Energy Status, Indian Energy Scenario.

UNIT – II

Introduction to Emerging Technologies In Energy Domain: Rational Use of Energy, Energy Efficiency and Conservation, New Technologies-Hydrogen Energy Systems, Fuel Cells, Biofuels, Distributed Energy Systems and Dispersed Generation.

UNIT – III

Environmental Aspects of Electric Energy generation: Introduction, Atmospheric Pollution, Oxides of Sulphur (SO2) ,Oxides of Nitrogen (NO_2) , Oxides of Carbon (CO, CO_2) , Thermal Pollution , Hydroelectric Projects, Nuclear Power Generation and Environment, Disposal of Nuclear Waste.

UNIT – IV

Global Climate Change Impact of energy resource: Introduction, Environmental Studies—A Multidisciplinary Approach, Air Pollution ,Water Pollution, Prominent Climate Change, Vulnerability and Impacts in India, Water Management in India-Clarion Call to Address Climate Change- Kyoto protocol

UNIT – V

Economic Evaluation: Basic Terms and Definitions, Calculations for -the Case of Single Payment (or Receipt), Uniform Series of Payments (or Receipt), Uniform Gradient Series of Payments (or Receipt) and Geometric Gradient Series of Payments (or Receipt) , Effect of Inflation on Cath Flows, Comparative Economic Evaluation of Alternatives, Effect of Depreciation and Tax on Cash Flows **.**

TEXT BOOKS:

1. B.H.Khan, "Non-Conventional Energy Resources", MCGrawHill Education (India) Pvt.Ltd.,2015
2. D.P.Kothari, K.C. Singal, Rakesh Ranjan, " Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, 2014.

SUGGESTED READING:

1. G.S.Sawhney, "Non-Conventional Energy Resources", PHI Learning Pvt.Ltd, 2012.

ONLINE RESOURCES:

1. https://elearn.nptel.ac.in/shop/nptel/energy-resources-economics-and-environment/?v=c86ee0d9d7ed

22EEO04

ENGINEERING MATERIALS
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: None

COURSE OBJECTIVES: This course aims to
1. Analyze the mechanical, magnetic and the electrical properties of materials.
2. Select materials for various engineering application to establish how failures occur in materials.
3. Observe the changes in behavior of the material while subjected to stress and to know the economic aspects of a design.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Classify the given material based on its properties.
2. Understand the concepts of superconductors & optical fibers.
3. Select a proper material for a given application.
4. Experiment on materials in order to test its adaptability.
5. Compare and contrast the characteristics of the materials to assess the changes in properties.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	-	-	-	2	-	-	-	-	1
CO 2	2	1	1	-	-	-	2	-	-	-	-	1
CO 3	1	1	1	-	1	-	2	-	-	-	-	1
CO 4	1	1	2	-	1	-	3	-	-	-	-	1
CO 5	1	1	2	-	2	-	3	-	-	-	-	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT- I

Conducting Materials: Electrical conducting Materials, High conductivity materials, Materials of High Resistivity, Materials used for precision work, rheostats, heating devices, Super conductivity, Special types of alloys, Applications &Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

UNIT -II

Superconductors & Optical fibers: Properties of Materials: Superconductivity-working-engineering applications- properties-classifications-superconducting transmission cables-optical Fibers.

UNIT- III

Insulating Materials: Classification of Insulting materials, temperature rise, electrical properties of insulating materials used for wires-laminations- machines and their applications, Ceramics, Plastics, DC electrical properties, AC electrical properties, Dielectric properties of insulators, Dielectric materials used for various electrical applications, suitability.

UNIT- IV

Magnetic Materials: Magnetic parameters, the three types of magnetic material, measuring magnetic materials, Application of soft magnetic materials, Magnetic recording media, Hard (permanent) magnets, Ferrites, Samarium, Cobalt alloys, Neodymium Iron Boron (Nd Fe B).

UNIT –V

Materials for Direct Energy Conversion Devices: Solar cells, equivalent circuit of a solar cell, fuel cell, MHD generators, storage of hydrogen, thermoelectric generators, Nano applications in Electrical Engineering.

TEXT BOOKS:

1. G.K Benergy, "Electrical and Electronic Engineering Materials", PHI, 2014
2. Ian P. Jones, "Materials Science for Electrical and Electronic Engineers",Oxford University Press, 2008.
3. R. K Sukhla, "Electrical Engineering Materials", McGraw Hill Education,2013.

SUGGESTED READING:

1. Dhir, "Electronic Components & Materials", McGraw Hill Education,2012.
2. "Electrical Engineering Materials", McGraw Hill Education, TTTI Madras, 2014

22EEO05

ENERGY AUDITING
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: None.

COURSE OBJECTIVES: This course aims to
1. Know the concept of Energy auditing
2. Understand the formulation of efficiency for various engineering systems
3. Explore the different ways to design various technologies for efficient engineering systems.

COURSE OUTCOMES: After the completion of this course, the student will be able After completion of this course, students will be able to:
1. Apply knowledge of energy forms to real-world engineering scenario.
2. Perform Energy audits using appropriate methodologies.
3. Implement Energy-saving measures in commercial buildings.
4. Identify the proper location of Capacitor for PF improvement
5. Apply Green concepts on different areas to minimize environmental impact.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	1	1	2	-	-	-	-	1	1
CO 2	2	1	3	2	1	2	-	-	-	-	1	1
CO 3	2	1	3	2	1	2	-	-	-	-	2	2
CO 4	2	1	2	2	1	2	-	-	-	-	2	2
CO 5	1	1	2	1	1	2	-	-	-	-	2	2

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Basics of Energy and its various forms: Overview of **-Energy -**elements Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, sources of Chemical energy, fuel cells, **World energy Scenario** ,Energy Scenario in India

UNIT-II

Energy Auditing-I: Introduction, Need for energy audit, types of energy audit: Preliminary audit, General/mini Audit, Investment-grade/ Comprehensive audit. Major energy consuming equipment and systems, Energy audit team, energy Auditing methodology: preliminary and detailed**,** Energy Audit report format

UNIT-III

Energy Auditing-II: For buildings: Energy Auditing Instruments, Energy Efficiency, Energy Auditing for buildings- and model analysis. Energy audit form of commercial buildings, such as Hotel, Energy Audit Case studies

UNIT –IV

Energy Efficient Technologies-I: Energy Efficient Technology in Mechanical Engineering**:** Heating, ventilation, and air-conditioning; Evaporative coolers, Air conditioners -types such as Portable; Central AC, Window AC and Split AC

Energy Efficient Technology in Electrical Engineering: Electricity billing, Power Factor Improvement- Regenerated Energy in Lifts and Escalators

UNIT-V

Energy Efficient Technologies-II: Energy Efficient Technology in Civil Engineering: Green building-features- -Green construction -Net Zero Energy Building - Energy Efficient Technology in Chemical Engineering: Green chemistry, - Battery Management systems – Green Chemistry topologies.

TEXT BOOKS:

1. Umesh Rathore, 'energy management', Kataria publications, 2nd ediiton, 2014.
2. G.Hari hara Iyer : Green Building– Fundamentals, Notion Press .com2022

SUGGESTED READING:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
2. Guide books for National Certification Examination for Energy Manager / EnergyAuditorsBook-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland Universityof Technology

ONLINE RESOURCES:

1. https://www.udemy.com/course/tools-for-energy-auditors/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_Catchall_la.EN_cc.INDIA&utm_content=deal4584&utm_term=_._ag_82569850245_._ad_533220805574_._kw__._de_c_._dm__._pl__._ti_dsa41250778272_._li_9062143_._pd__._&matchtype=&gad_source=1&gclid=Cj0KCQjw8J6wBhDXARIsAPo7QA-xSK3NrdJaj-_2RyiJD3KTuCW1kN27TD8Hfd1zRPIQpRqDK24ntYIaAhUbEALw_wcB&couponCode=IND21PM

22EEO06

WASTE MANAGEMENT
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: None.

COURSE OBJECTIVES: THIS COURSE AIMS TO

1. Provide the concept of effective utilization of any scrap
2. Dispense the processes of all disciplines of engineering.
3. Impart the technique of connectivity from waste to utility.

COURSE OUTCOMES: after the completion of this course, the student will be able

1. Categorize the waste based on the physical and chemical properties.
2. Explain the hazardous waste management and treatment process.
3. Illustrate the environmental risk assessment, methods, mitigation and control.
4. Interpret the biological treatment of solid and hazardous waste.
5. Identify the waste disposal options; describe the design and construction, operation, monitoring, closure of landfills.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	2	-	-	2	1	-	-	-	-	1
CO 2	2	1	2	-	-	2	1	-	-	-	-	1
CO 3	2	1	3	-	-	2	1	-	-	-	-	1
CO 4	2	3	3	-	-	2	1	-	-	-	-	1
CO 5	2	3	3	-	-	2	1	-	-	-	-	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT -I

Introduction to Waste Management and Municipal Solid Waste Management: Classification of waste, Agro based, Forest residue, Industrial waste, e-Waste, Municipal Solid Waste Management, Fundamentals Sources, Composition, Generation rates, Collection of waste, Separation, Transfer and Transport of waste, Treatment and disposal options.

UNIT -II

Hazardous Waste Management and Treatment: Hazardous waste identification and classification, Hazardous waste management: Generation, Storage and collection, Transfer and transport, Processing, Disposal, Hazardous waste treatment: Physical and chemical treatment, Thermal treatment, Biological treatment, Pollution prevention and waste minimization, Hazardous wastes management in India.

UNIT -III

Environmental Risk Assessment: Defining risk and environmental risk, Parameters for toxicity quantification, Types of exposure, Bio-magnifications, Effects of exposure to toxic chemicals, Risk analysis and Risk matrix, Methods of risk assessment, Mitigation and control of the risk, Case studies.

UNIT -IV

Biological Treatment: Solid and hazardous waste composting, Bioreactors, Anaerobic decomposition of solid waste, Principles of biodegradation of toxic waste, Inhibition, Co-Metabolism, Oxidative and reductive processes, Slurry phase bioreactor, In-situ-remediation.

UNIT -V:

Waste Disposal: Key issues in waste disposal, Disposal options and selection criteria, Sanitary landfill principle, Landfill processes, Landfill gas emission: Composition and properties, Hazards, Migration, Control, Leach ate Formation: Composition and properties. Leach ate migration, Control, Treatment, Environmental effects of landfill, Landfill operation issues, Design and construction, Operation, Monitoring, Closure of landfills-Landfill remediation, National and International waste management programs.

TEXT BOOKS:

1. John Pichtel, Waste Management Practices CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham, P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, NewYork, 1994
3. Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, NewYork, 1997.

SUGGESTED READING:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by KantiL.Shah 1999, Prentice Hall.
2. Solid and Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.

22EEO07

FUNDAMENTALS OF ELECTRIC VEHICLES

(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: None.

COURSE OBJECTIVES: This course aims to know

1. Basics of Electric Vehicle history and components.
2. Various types of Electric Vehicles.
3. Different storage methods.

COURSE OUTCOMES After the completion of this course, the student will be able to

1. Understand the basics of electric vehicle and environmental impact.
2. Understand the various types of Electric Vehicles and their properties
3. Understand the functioning of BEV.
4. Understand the difference between HEV and FCEV.
5. Understand the various methods of energy storage.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	-	-	2	3	-	2	1	2	1
CO 2	1	1	1	-	-	2	3	-	2	1	2	1
CO 3	1	1	1	-	-	2	3	-	2	1	2	1
CO 4	1	1	1	-	-	2	3	-	2	1	2	1
CO 5	1	1	1	-	-	2	3	-	2	1	2	1

1 - Slightly, 2 - Moderately, 3 - Substantially

UNIT-I

Introduction to Electric vehicles: Present scenario of electric vehicles, Need of Electric Vehicles, Economic and environmental impacts of using Electrical vehicles. Challenges faced by electric vehicles to replace ICE. Major requirements of electric vehicles.

UNIT-II

Types of Electric Vehicle and their challenges: Types of Electric Vehicle - Pure Electric Vehicle (PEV): Battery Electric Vehicle (BEV), Fuel Cell Electric Vehicle (FCEV), and Hybrid Electric Vehicle (HEV). Challenges of Battery Electric Vehicle, Hybrid Electric Vehicle and Fuel Cell Electric Vehicle

UNIT -III

Battery Electrical Vehicle: Components of BEV drive train, The electric propulsion subsystem - Driving wheels , Suspension system, Driveshaft, Mechanical transmission , Electric Motor. The energy source subsystem -Battery pack with Battery Management System, On board charger, The auxiliary subsystem -Power steering unit, Common parts between ICE drive train and EV drive train, Differences (modifications/parts to be removed/added) between ICE and EV drive train.

UNIT-IV

Hybrid Electrical Vehicle and Fuel Cell Electric Vehicle: Hybrid Electric vehicle (HEV) -Basic architecture of hybrid drive trains, Components of HEV drive train system. Classification of HEV: Grid -Able HEV (Plug in hybrid, Range extended).Fuel efficiency in HEV. Fuel Cell Electric Vehicle (FCEV) - Basic architecture of FCEV. Components of FCEV drive train system.

UNIT-V

Energy Storage: Battery based energy storage, Overview of batteries, Battery Parameters, Battery Charging, regenerative braking, alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, and flywheels.

TEXT BOOKS:

1. A.K. Babu, "Electric & Hybrid Vehicles" , Khanna Publishing House, New Delhi, 2018.
2. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals" , CRCPress, Second Edition, 2011.

SUGGESTED READING:

1. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.
2. Mehrdad Ehsani,Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
3. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Inline with AICTE Model Curriculum with effect from AY 2023-2024

LIST OF OPEN ELECTIVES OFFERED BY THE DEPARTMENT OF BIOTECHNOLOGY

S. No	Subject Code	Subject Name
1	22BTO01	Biology For Engineers
2	22BTO02	Biomaterials For Engineers
3	22BTO03	Bioterrorism And National Security
4	22BTO04	Bioinformatics
5	22BTO05	Cognitive Neuroscience

22BTO01

BIOLOGY FOR ENGINEERS
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to
1. Understand the milestones reached by the human in the field of biology.
2. Understand the human body and its parts.
3. Understand the human anatomy and medical devices.
4. Understand types of advanced therapies.
5. Understand the treatment of toxic pollutants in the environment.
6. Understand genome sequencing and NGS.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Appraise the values of Biology in classical and modern time
2. Develop modern instruments related to the skeletal, nervous, and circulatory system
3. Apply the concept of respiratory, excretory, and assisted reproductive processes for developing related instruments
4. Illustrate the modern interdisciplinary tools related to medical biotechnology and bioremediation
5. Summarize the basic knowledge about nucleic acids, proteins, and their sequencing

CO-PO ARTICULATION MATRIX

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	2	2	0	0	0	0	2
CO2	1	0	0	0	2	0	1	0	0	0	0	0
CO3	1	0	1	0	2	0	1	1	0	0	0	0
CO4	2	1	1	0	2	0	2	0	0	1	0	0
CO5	1	1	1	0	1	0	1	0	0	1	0	1

***The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction to Biology: Classical Vs Modern Biology; Importance of Biological Science and Historical Developments; Origin of Life, Urey Miller Experiment, Spontaneous Generation Theory; Three Domains of Life; Principle and Applications of Microscope (Light and Electron Microscope), Prokaryotic and Eukaryotic Cell- Structure and their differences.

UNIT II

Human Anatomy and Functions-I: Human organ systems and their functions; Skeletal System- Bones, Tendon, Ligaments, principle and applications in knee replacement; Nervous System - Structure of Brain, Spinal Cord, Neuron, Neurotransmitters, Synapse, Alzheimer's - a case study, principle, and applications of Imaging Techniques (CT & MRI scans); Circulatory System - Heart structure and functions, principle and applications of cardiac devices (Stent and Pacemaker), Artificial heart, blood components, and typing, hemocytometer.

UNIT III

Human Anatomy and Functions-II: Respiratory Systems - Lung structure and function, principle, and applications of Peak Flow Meter, ECMO (Extra Corporeal Membrane Oxygenation); Excretory Systems-Kidney structure and unction, principle and applications of Dialysis; Prenatal diagnosis; Assisted reproductive techniques- IVF, Surrogacy.

UNIT IV

Medical Biotechnology and Bioremediation: Cells of Immune System, Etiology of cancer, Cancer treatment (Radiation Therapy); Stem Cells and its Clinical applications; Scaffolds and 3D printing of organs; Biosensors and their applications; Parts of bioreactor and its types; Bioremediation.

UNIT V

Bioinformatics: Nucleic acid composition, Genetic Code, Amino acid, Polypeptide, Levels of protein structure, Homolog, Ortholog and Paralog, Phylogenetics, Genome Sequencing, Human Genome Project, Next generation sequencing.

TEXT BOOKS:

1. Champbell, N.A., Reece, J.B., Urry, Lisa, Cain, M, L., Wasserman, S.A., Minorsky, P.V., Jackson, R.B., "Biology: A global approach", Pearson Education Ltd, Edition 11, 2017.
2. Shier, David, Butler, Jackie, Lewis, Ricki., "Hole's Human Anatomy & Physiology"., McGraw Hill 2012.

SUGGESTED READING:

1. Bernard R. Glick, T. L. Delovitch, Cheryl L. Patten, "Medical Biotechnology", ASM Press, 2014.

22BTO02

BIOMATERIALS FOR ENGINEERS
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: Undergraduate First-year basic concepts of physics and chemistry are required

COURSE OBJECTIVES: This course aims to
1. To learn the types and trends of Biomaterials.
2. To recognize the procedures for manufacturing of Metallic Biomaterials.
3. To be aware of the types of ceramic Biomaterials.
4. To elaborate on the detailed features of polymer and composite Biomaterials.
5. To learn the applications of Biomaterials.

COURSE OUTCOMES: After completion of this course, student will be able to
1. Explain the types and properties of Biomaterials.
2. Compare the techniques for the manufacture of metallic Biomaterials and their use in the healthcare industry.
3. Outline the physiological properties and various techniques for the manufacture of ceramic biomaterials.
4. Illustrate the preparation of the polymer and composite Biomaterials.
5. Apply the different types of Biomaterials in the health industry.

CO-PO ARTICULATION MATRIX

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	2	2	1	-	1	-	3
CO2	1	1	2	1	-	2	2	1	-	-	-	3
CO3	1	1	2	2	-	2	1	2	-	-	-	3
CO4	1	2	2	2	-	1	1	1	1	1	-	3
CO5	1	1	2	2	-	1	2	1	1	1	-	3

***The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction to Biomaterials: Introduction and importance of biomaterials; Types of biomaterials: metallic, ceramic, polymeric, and composite biomaterials; Future trends in biomaterials.

UNIT II

Metallic Biomaterials: Properties of metallic biomaterials; Stainless steels; CoCr alloys; Ti alloys; Corrosion of metallic implants; Manufacturing of implants. Dental implants and their biocompatibility

UNIT III

Ceramic Biomaterials: Properties of ceramic biomaterials; Classification according to the physiological response of ceramic biomaterials: bioinert, bioactive, and bioresorbable ceramics; Deterioration of ceramics; Bioceramic manufacturing techniques

UNIT IV

Polymeric and composite biomaterials: Polymerization and basic structure; Polymers used as biomaterials; Properties of polymeric and composite biomaterials; Sterilization; Surface modifications for improving biocompatibility; Surface-protein interactions.

UNIT-V

Applications of Biomaterials: Applications of biomaterials in tissue engineering; Drug delivery; Biosensing; Diagnostics.

TEXT BOOKS:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E An Introduction to Materials in Medicine, (Elsevier Academic Press, ISBN: 0-12-582463-7), 2002.
2. 2. J.B. Park and J.D. Bronzino. Biomaterials: Principles and Applications. CRC Press. 2002. ISBN: 0849314917
3. K.C. Dee, D.A. Puleo and R. Bizios. An Introduction to Tissue-Biomaterial Interactions. Wiley 2002. ISBN: 0-471-25394-4.

REFERENCE BOOKS:

1. T.S. Hin (Ed.) Engineering Materials for Biomedical Applications. World Scientific. 2004. ISBN 981-256-061-0
2. Rolando (Ed.) Integrated Biomaterials Science. Springer. 2002. ISBN: 0-306-46678-3.

22BTO03

BIOTERRORISM AND NATIONAL SECURITY
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to

1. Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.
2. To provide students with an in-depth characterization of different forms of bioterrorism, agroterrorism, and surveillance.
3. To define bioterrorism and forensics, the law and bioterrorism, and to present a sociological perspective on biodefense and bioterrorism
4. To provide students with contacts with faculty members, health care providers, and industry experts as a resource for information on biological threats.

COURSE OUTCOMES: After completion of this course, student will be able to

Exposure to threats to national security, methods to tackle them and support law enforcement & health agencies to handle them.

1. Evaluate different types of bioterrorism challenges.
2. Assess various categories of agents for bioterrorism.
3. Illustrate the various aspects of a bioweapon and associated case studies.
4. Apply the techniques for the detection of bioterrorism.
5. Summarize key national and international legal principles and sources that address bioterrorism

CO-PO ARTICULATION MATRIX

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	1	1	2	2	1	0	0	0	0
CO2	1	0	0	0	1	3	1	0	0	0	0	0
CO3	1	0	0	1	1	2	1	2	0	0	0	0
CO4	2	1	0	1	1	2	2	0	0	0	0	0
CO5	1	0	0	0	0	3	2	1	0	0	0	2

*** The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Terrorism and Bioterrorism: Definition and Historical perspective of Bioterrorism, Traditional terrorists & New terrorists (Nuclear, chemical, and radiological weapons), Agroterrorism, Bio surveillance & Bio diagnostics.

UNIT II

Types of Bioterrorism Agents: Primary classes of Microbes-bacteria, viruses, and other Agents. and their mechanism as terrorists in living systems. High-priority agents (Ebola virus), Moderate-priority agents (Brucellosis, Q fever), Low-priority agents (Yellow fever virus, Hantavirus)

UNIT III

Bio-weapons and Techniques: Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity- Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF. Genetically Engineered Microbes

UNIT IV

Prevention and Control of Bioterrorism: Surveillance and detection, Detection equipment and sensors, Novel Detections Methods for Bioagents, Industrialized Production of a Vaccine for a Bioagent, Biosecurity in the Food Industry

UNIT V

Bioterrorism Management: Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control, and industry Support-Microbial forensics. Role of National and International Organizations in Prevention and Control of Bioterrorism

TEXT BOOKS:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press, 1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

REFERENCE BOOKS:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

22BTO04

BIOINFORMATICS
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to

1. To provide elementary knowledge in biology and bioinformatics and biological information available to a biologist on the web and learn how to use these resources on their own.
2. To learn the fundamentals of biological databases, Sequence analysis, data mining, sequence alignment, and phylogenetics
3. To learn methods for determining the predicting gene and protein

COURSE OUTCOMES: After completion of this course, student will be able to

1. Explain the basic concepts of biology and bioinformatics
2. Identify various types of biological databases used for the retrieval and analysis of the information
3. Explain the sequence analysis and data mining
4. Discuss the methods used for sequence alignment and construction of the phylogenetic tree
5. Describe the methods used for gene and protein structure prediction

CO-PO ARTICULATION MATRIX

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	0	0	0	0	0	0	0	0	1	0	1
CO2	1	1	0	1	1	0	0	0	0	1	0	1
CO3	2	0	0	1	1	0	0	0	0	1	0	1
CO4	2	0	0	1	1	0	0	0	0	1	0	1
CO5	2	1	0	1	1	0	0	0	0	1	0	1

*** The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table**

UNIT I

Introduction And Basic Biology: Basics of DNA, RNA, Gene and its structure, Protein and metabolic pathway; Central dogma of molecular biology; Bioinformatics- Introduction, Scope and Applications of Bioinformatics; Genome sequencing, Human Genome Project; Impact of Bioinformatics on allied fields of study.

UNIT II

Biological Databases: Introduction to Genomic Data and Data Organization, types of databases, biological databases and their classification, Biological Databases - NCBI, SWISS PROT/Uniport, Protein Data Bank, Sequence formats; Information retrieval from biological databases; Data mining of biological databases

UNIT III

Sequence Analysis and Data Mining: Scoring matrices, Amino acid substitution matrices- PAM and BLOSUM; Gap, Gap penalty; Database similarity searching - BLAST, FASTA algorithms to analyze sequence data, FASTA, and BLAST algorithms comparison; Data Mining- Selection and Sampling, Pre-processing and Cleaning, Transformation and Reduction, Data Mining Methods, Evaluation, Visualization, Designing new queries, Pattern Recognition and Discovery, Text Mining Tools

UNIT IV

Sequence Alignment and Phylogenetic: Sequence Alignment – Local and Global alignment; Pairwise sequence alignment – Dynamic Programming method for sequence alignment - Needleman and Wunsch algorithm and Smith-Waterman algorithm. Multiple sequence alignment - Methods of multiple sequence alignment, evaluating multiple alignments, applications of multiple sequence alignment. Concept of the tree, terminology, Methods of phylogenetic analysis, tree evaluation – bootstrapping, jackknifing

UNIT V

Macromolecular Structure Prediction:

Gene prediction, - neural networks method, pattern discrimination methods, conserved domain analysis; Protein structure basics, protein structure visualization, Secondary Structure predictions; prediction algorithms; Chou-Fasman and GOR method, Neural Network models, nearest neighbour methods, Hidden-Markov model, Tertiary Structure predictions; prediction algorithms; homology modelling, threading and fold recognition, ab initio prediction.

TEXT BOOKS:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N, and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug Discovery", 5th edition, PHI Learning Private Limited, New Delhi, 2022

SUGGESTED READING:

1. Baxebanis AD and Francis Ouellette BF, "Bioinformatics a practical guide the analysis of genes and proteins", 2nd edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, "Bioinformatics: A modern approach. PHI Learning Private Limited", New Delhi, 2009
3. JiXiong, "Essential Bioinformatics", Cambridge University Press, 2006

22BTO05

COGNITIVE NEUROSCIENCE
(Open Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

PREREQUISITES: School-level basic knowledge in Fundamental science is required

COURSE OBJECTIVES: This course aims to

1. Understanding the brain effects that give rise to our abilities to perceive, act and think
2. Gain skills on the way that cognition is associated with neural activity
3. Compare and contrast the organization and function of numerous systems within the brain

COURSE OUTCOMES: After completion of this course, student will be able to

1. Gain familiarity and basic knowledge about brain systems and functions.
2. Understand the brain's neurotransmitter system.
3. Understanding the brain's methods gives rise to behavior whether we engage in any activity (e.g., walking, talking, etc.).
4. Identify the patterns of varied activities in neurons that correspond to a person's attempts to move in particular ways.
5. Understand the feedback system and brain disorders.

CO-PO ARTICULATION MATRIX

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	0	2	0	0	0	2	0	3
CO2	1	1	1	1	0	2	0	0	0	2	0	3
CO3	1	1	1	1	0	2	0	0	0	2	0	3
CO4	1	2	2	3	3	3	0	3	1	3	0	3
CO5	1	1	2	3	3	3	0	3	1	3	0	3

The above table applies to the biotechnology department. Respective departments opting for this subject may prepare a similar table

UNIT I

Introduction to neuroscience: Outline of neuroanatomical; Neurogenesis, migration Axon path-finding; cell death; Role of neural activity in development; Membranes and membrane potentials.

UNIT II

Action potential: Conductance mechanisms; Chemical and electrical transmission; Postsynaptic potentials; neural integration; Energy consumption in the brain; Attention; Methods jigsaw; Executive Control; Evolution/development; Sheep's brain dissection.

UNIT III

Neurotransmitter systems: Visual information processing; Visual cortex; Visual plasticity; critical periods; Somatosensory system; Pain; Chemoreception; Auditory system; Spinal mechanisms; Brain mechanisms.

UNIT IV

Human and Animal Memory: Pattern completion and separation; LTP and synapses; Spatial cognition; Social cognition; Cellular mechanisms of neural plasticity.

UNIT V

Feedback System and Brain Disorders: Endocrine systems; feeding behavior, Stress, Addiction, Depression, Schizophrenia, Alzheimer's, Huntington's disease, Parkinson's disease.

TEXT BOOKS:

1. Principles of Neural Science, 6th Edition (2021) Eric R. Kandel, James Harris Schwartz, Thomas M. Jessell, McGraw Hill.
2. Principles of Cognitive Neuroscience, 2nd Edition (2013) Dale Purves, Roberto Cabeza, Scott A. Huettel, Kevin S. LaBar, Michael L. Platt, and Marty G. Woldorff. Sinauer Associates, Inc.
3. Mark Bear, Brian Connors, and Michael Paradiso (2007) Neuroscience: Exploring the Brain. 3rd ed. Baltimore: Lippincott, Williams & Wilkins.

Department of Chemical Engineering

List of Open electives offered to other departments in R 22 Scheme

S.no	Course Code	Course Name
1.	22CHO01	Fuel Cells and Batteries
2.	22CHO02	Fundamentals of Nano Science and Nano Technology
3.	22CHO03	Industrial Pollution Control
4	22CH O04	Environmental and Sustainable Development
5.	22CH O05	Material Science Engineering
6.	22CH O06	Safety and Hazards Management

22CHO01

FUEL CELL AND BATTERIES

(Open Elective)

Instruction	3L Periods per week3 Hours
Duration of SEESEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to :

1. Create awareness about alternate clean fuel available.
2. Evaluate the concepts and chemistry of fuel cell
3. Examine the details of fuel used in fuel cell technology
4. Explain the application of fuel cell in different sectors
5. Evaluate the fuel cell system balance plant and future opportunities

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Apply know-how of thermodynamics, electrochemistry and principle of fuel cell
2. Understand the different types of fuel cell
3. Understand the components of hydrogen-based fuel cell
4. Explain the application of fuel cell in transport, stationary and portable sector
5. Understand the impact of this technology in a global and societal context

CO-PO-PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	2	3	-	-	-	1	2
CO2	3	3	3	-	-	2	2	-	-	-	1	2
CO3	3	3	3	-	-	2	2	-	-	-	1	2
CO4	3	3	3	-	-	2	2	-	-	-	1	2
CO5	3	3	3	-	2	2	3	-	-	-	1	2

UNIT - I

Introduction: Electrochemical Systems and Fuel Cell, Fuel Cell Fundamentals and Basic Concepts, Fuel Cell Degradation, Fuel Cell Operation, Types Of Fuel Cell And Its Applications: Direct Carbon Fuel Cell, Solid Oxide Fuel Cell, Polymer Electrolyte Fuel Cell, Alkaline Fuel Cell, Phosphoric Acid Fuel Cell, Molten Carbonate FuelCell, Fuel Cell Thermodynamics - Heat, Work Potentials, Prediction of Reversible Voltage, Fuel Cell Efficiency.

UNIT – II

Fuels and Fuel Processing: Introduction, Feedstock for H_2 production: Natural gas, Liquefied petroleum gas, Liquid hydrocarbon Fuels: Gasoline and Diesel, Alcohols- Methanol and Ethanol, Ammonia, Biomass, Fuel processing for fuel cell applications: Desulfurization, fuel

reforming, water gas shift reaction, Carbon monoxide Removal.

UNIT – III

Fundamental and Components of Portable Hydrogen Fuel Cell: Introduction, PEM Fuel cell Components and their properties: Membrane, Electrode, Gas diffusion layer, Bipolar plates, Stack design principles, system design, performance analysis, current/voltage, voltage efficiency and power density, ohmic resistance, direct methanol and other non-hydrogen fuel cells, biofuel cell

UNIT – IV

Application of Fuel Cell: Hydrogen fuel cell use in transport, stationary Fuel cell characterization: - in-situ and ex- situ characterization techniques, i-V curve, frequency response analyses; Fuel cell modelling and system integration:

- 1D model - Analytical solution and CFD models.

UNIT – V:

Balance of plant and commercialization issues, Future Opportunities, obstacles and challenges associated in fuel cellsystems, impact of this technology in a global and societal context

Text Books

1. Nigel M. Sammes ,Fuel Cell Technology, Reaching Towards Commercialization, Springer London, 2006.
2. David A Berry, Dushyant Shekhawat, J.J. Spivey, Fuel Cells: Technologies for Fuel Processing, , Elsevier Science, 2011.

Suggested Readings

1. Shigenori Mitsushima, Viktor Hacker Fuel Cells and Hydrogen, From Fundamentals to Applied Research, Elsevier Science, 2018.

Online Resources

1. https://archive.nptel.ac.in/courses/103/102/103102015/#

22CHO02 FUNDAMENTALS OF NANO SCIENCE AND NANO TECHNOLOGY

Instruction	3(3L+0T) Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives This course aims to give some understanding on

1. The introduction and classification of nanoscience and nanomaterials
2. Explain the unique properties of nanomaterials.
3. The various synthesis routes of nanomaterials
4. The tools required for the characterization of nanomaterials.
5. The applications of nanomaterials.

Course Outcomes At the end of the course, the students will be able to

1. Explain the types of nanomaterials and classify them.
2. Understand various defects, and the effect of nano dimensions on the material behavior.
3. Discuss the bottom up and top-down synthesis of nanomaterials.
4. Explain the characterization of nanomaterials using various techniques.
5. Enlist and explain various applications of nanomaterials in diversified fields and areas.

CO-PO-PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	1	1	-	-	1	1	-	-	-	-	2
2	2	1	1	-	-	1	1	-	-	-	-	2
3	2	1	1	-	-	1	1	-	-	-	-	2
4	2	1	1	-	-	1	1	-	-	-	-	2
5	2	1	1	-	-	1	1	-	-	-	-	2

Unit I: Introduction

History and scope, classification of nanostructured materials, Fascinating nanostructures, applications of nanomaterials

Unit II: Unique properties of nanomaterials

Microstructure and defects in nanocrystalline materials – dislocations, Twins, stacking faults and voids, Grain boundaries, triple junctions and disclinations.

Effect of nano-dimensions on materials behavior – Elastic properties, magnetic properties, electrical properties, optical properties, thermal properties, and mechanical properties.

Unit III: Synthesis Routes

Bottom-up approaches – PVD, CVD, sol-gel process, wet chemical synthesis and self-assembly.

Top-down approaches – mechanical alloying, nanolithography.

Unit IV: Tools to Characterize Nanomaterials

Scanning electron microscopy, transmission electron microscopy, x-ray diffraction, atomic force microscopy, nanoindentation

Unit V: Applications of Nanomaterials

Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalyst, Food and Agriculture Industry, Cosmetics and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the Environment, Nano-medical Applications, Textiles, Paints, Energy, Defense and Space Applications.

Textbooks:

1. Murty BS, Shankar P, Baldev Raj, Rath BB, James Murday. Textbook of Nanoscience and Nanotechnology. Bangalore: Springer; 2013.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wiley India Edition, 2012.

Suggested Readings:

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira, and Daniel L. Schodek
3. Transport in Nano structures- David Ferry, Cambridge University press 2000.
4. Nanofabrication towards biomedical application: Techniques, tools, Application, and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

Online Resources:

1. Nanotechnology, Science and Applications by Prof. Prathap Haridoss, IIT Madras https://onlinecourses.nptel.ac.in/noc22_mm33/preview
2. Introduction to Nanoscience and Nanotechnology, Prof. Dr. Swapna Nair, Central University of Kerala https://onlinecourses.swayam2.ac.in/cec24_cy03/preview

22CHO03 INDUSTRIAL POLLUTION CONTROL

(Open Elective)

Instruction	3 Hours per week
Duration of SEE	3 Hrs
CIE	40 Marks
SEE	60 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Effects of pollution on environment and ecosystems
2. Types and sources of pollution
3. Measurement of air and water pollution
4. Different methods and equipment used in pollution abatement
5. Management practices in solid and hazardous wastes.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Differentiate the types of wastes generated in an industry, their effects on living and non-living things
2. Understand the effect of climate changes, atmospheric dispersion of air pollutants, and operating principles.
3. Understand working principles of particulate control devices.
4. Quantify wastewater and Assess treatment technologies for wastewater
5. Select treatment methodologies for hazardous and E-waste

CO-PO-PSO Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	2	1	1	1	1	1	2
CO2	2	2	2	2	1	1	2	1	1	1	1	2
CO3	2	2	1	1	1	2	2	1	1	1	1	2
CO4	2	1	2	1	1	2	3	1	1	1	1	2
CO5	2	2	2	2	1	1	3	1	1	1	1	2

UNIT- I: Introduction

Definition and types of pollution. Effects of pollution on environment and ecosystems - global warming - greenhouse effect. Laws and standards for pollution. Sources, types, characteristics and effects of air pollutants, liquid effluents, solid wastes industries.

UNIT- II: Air Pollution

Meteorological aspects of pollution dispersion, Temperature lapse rates, Turbulence and stability of atmosphere. Indoor air pollution - smoke and hydrocarbons. Richardson Number, Plume raise, plume behavior and characteristics, effective stack height.

UNIT III: **Air Pollution General Control Methods and Equipment:**

Removal of sulphur dioxide, oxides of nitrogen and carbon, organic vapors from gaseous effluents. Removal of particulate matter - principle and working of settling chambers cyclone separators solid traps, fabric and fiber filters, electro-static precipitators.

UNIT IV: Introduction to water pollution –Origin of wastewater, types of water pollutants and their effects., Determination of organic matter, Determination of inorganic substances, Physical characteristics, Bacteriological measurement, Zero liquid discharge, wastewater treatment methods –

RO, UF, Grey water recycling.

UNIT –V: Solid and Hazardous Waste

Solid waste management: Sources and classification, Public health aspects, Methods of collection, Disposal Methods,. Hazardous waste management: Definition and sources, Hazardous waste classification, Treatment methods, Disposal methods. E-waste: Sources, environmental and social issues, management practices.

Text Books

1. C.S.Rao, "Environmental Pollution Control Engineering", 3rd Ed, New Age International, 2018.
2. S.C. Bhatia, " Solid And Hazardous Waste Management ", Atlantic Publishers, 2021

Suggested Reading:

1. Metcalf and Eddy, "Wastewater Engineering: Treatment and Reuse", 4th Ed, MGH publishing, 2004.
2. M.N Rao and H.V.N Rao, "Air Pollution", Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000.
3. Lakshmi Raghupathy**,** "Introduction to E-Waste Management" TERI Press,
4. Peavy, H.S., Rowe, D.R. and Technobanolous, G., "Environmental Engineering", McGraw Hill, 1985.

Online resources:

1. Basic Environmental Engineering and Pollution Abatement

   https://archive.nptel.ac.in/courses/103/107/103107215/

22CH O04 **ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT**

Instruction	3(3L+0T) Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to This course will help the students:

1. To have an increased awareness on issues in areas of sustainability
2. To understand the role of engineering & technology within sustainable development
3. To know the methods, tools and incentives for sustainable product service system development
4. To establish a clear understanding of the role and impact of various aspects of engineering decisions on environmental, societal and economic problems.
5. To communicate results related to their research on sustainable engineering

COURSE OUTCOMES: After the completion of this course, the student will be able At the completion of this course, students will be able to:

1. Understand the concept of sustainable engineering and its significance in addressing contemporary environmental challenges.
2. Explore the 4R concept of solid waste management and examine various tools and methodologies to assess and mitigate the environmental impacts of engineering activities.
3. To be aware of the principles and requirements of environmental management standards and their application in promoting environmental sustainability.
4. Analyze the challenges and opportunities associated with promoting sustainable habitats such as sustainable cities, sustainable transport, sustainable sources of energy conventional and sustainable materials for green buildings
5. Understand and evaluate the industrial processes through the principles of industrial ecology and industrial symbiosis.

CO-PO-PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	3	1	1	2	3	2	1	1	1	3
CO2	2	2	3	2	1	2	3	2	1	1	1	3
CO3	2	1	3	1	2	2	3	2	1	2	1	3
CO4	3	1	3	3	1	3	3	2	2	1	1	3
CO5	3	3	3	1	2	2	3	2	1	1	2	3

UNIT I

Introduction of sustainability- Need and concept of Sustainable Engineering, Social-environmental and economic sustainability concepts, Sustainable development and challenges, Sustainable Development Goals, Environmental acts and protocols – Clean Development Mechanism (CDM).

UNIT II

Economic and social factors affecting sustainability, Effects of pollution from natural sources, Solid waste-sources, impacts, 4R (Reduce, Reuse, Recycling, Recover) concept, Ozone layer depletion, Global warming, Tools used to ensure sustainability in engineering activities such as environmental management systems and environmental impact assessment studies.

UNIT III

Global, Regional and Local environmental issues, Carbon credits and Carbon trading, Carbon foot print, Environmental management standards, ISO 14000 series, Life cycle Analysis (LCA)-scope and goal, Procedures of EIA (Environment Impact Assessment) in India.

UNIT IV

Basic concept of sustainable habitat-Sustainable cities, Sustainable transport, Sustainable sources of energy conventional and renewable sources, Green Engineering: Green buildings, Green materials for sustainable design, Methods for increasing energy efficiencies of buildings**.**

UNIT V

Technology and sustainable development, Sustainable urbanization, Industrialization and poverty reduction, Social and Technological change, Industrial processes-material selection, Pollution prevention, Industrial ecology, Industrial symbiosis.

Text book:

1. Rag R. L., Introduction to Sustainable Engineering, 2nd Ed, PHI Learning Pvt Ltd, 2016.
2. Allen D. T and Shonnard D. R., Sustainability Engineering Concepts, Design and Case Studies, 1 st Ed, Prentice Hall, 2011.

Suggested Reading

1. Bradley A. S, Adebayo A. O and Maria. P., Engineering Applications in Sustainable Design and Development, 1st Ed, Cengage Learning, 2016.
2. Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams., Sustainable Engineering,1st Ed, Wiley, 2019.

Online resources:

1. Sustainable Engineering concepts and Life cycle analysis
   https://archive.nptel.ac.in/courses/105/105/105105157/
2. Sustainable Energy Technology

https://onlinecourses.nptel.ac.in/noc23_me138/preview

22CHO05 **MATERIAL SCIENCE ENGINEERING**
(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to This course helps the students to understand the

1. Introduction to different types of engineering materials and alloys
2. Alloying elements and factors for material selection
3. Significant properties of engineering materials
4. Specific requirements of materials for high and low temperature applications.
5. Possible and latest alternatives available for standard engineering materials.

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completing this course, students will be able to:

1. Classify different engineering materials as ferrous and non-ferrous alloys.
2. Compare mechanical and thermal properties of engineering materials
3. Select materials for high and low temperature applications.
4. Identify new or alternate materials for development and operation of process industry.
5. Understand the significance and applications of Biomaterials

CO, PO and PSO Correlation Matrix

	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	3	3	2	1	1	0	-	-	-	-
CO2	3	3	3	3	3	2	0	1	-	-	-	-
CO3	3	3	3	3	3	2	3	1	-	-	-	-
CO4	3	3	3	3	3	3	3	1	-	-	-	-
CO5	3	3	3	3	3	3	3	2	-	-	-	-

UNIT-I Introduction to Engineering Materials: Classification – metals, non-metals, alloys; Criteria for material selection. Ferrous metals and alloys - types of steels like mild, carbon and stainless steel, common grades of steel – 304 and 316; Non-Ferrous metals and alloys of Aluminium, Copper and Nickel;

UNIT-II General Properties of Engineering Materials: Mechanical Properties: Stress-strain diagram, Elastic, Plastic, Anelastic and Viscoelastic behavior. Creep, Fatigue and Fracture strengthening mechanisms; **Thermal Properties:** Conductivity, Expansion, Protection, Diffusivity, Stresses and Shock resistance;

UNIT-III Materials for High and Low Temperature Applications: Classification, advantages, general properties and applications of engineering materials like Refractories, Ceramics, Super alloys, Composites

UNIT-IV New materials: Nano-materials: carbon nanotubes, fullerene, nanosensors; **Nanocomposites,** role of reinforcement-matrix interface strength on composite behaviour
Smart materials: Piezoelectrics, shape memory alloys, Magneto-strictive, electro-rheological materials, 3D printing.

UNIT-V Biomaterials: Biomaterials: Biocompatibility, advantages, properties, uses, Types - Nearly inert, surface active, resorbable.

Text Books

1. Materials Science and Engineering an Introduction, William D. Callister, Jr. 5thEd., John Wiley and Sons, Inc. 2002.

Suggested Readings:

1. Fundamentals of Smart Materials, Mohsen Shahinpoor, The Royal Society of Chemistry Publishing, U.K, 2020.
2. B. S. Mitchell An Introduction to Materials Engineering and Science for Chemical and Materials Engineers, John Wiley & Sons, 2004.
3. S. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007.

Online Resources:

1. Nature And Properties of Materials, by Prof. Bisakh Bhattacharya, Department of Mechanical Engineering IIT Kanpur
   https://archive.nptel.ac.in/courses/112/104/112104203/

22CHO06 **SAFETY HAZARDS AND MANAGEMENT**
(Open Elective)

Instruction	3Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to This course will help the students to understand the

1. Importance of safety culture in process industry.
2. Disregard for ethical decision making based on numerous case studies.
3. Interaction and implementation of trade-offs concept in chemical plant operation.
4. Examples of problems that can occur with inadequate process design, improper process modification.
5. Different case studies related to industrial processes

COURSE OUTCOMES: After the completion of this course, the student will be able At the completion of this course, students will be able to

1. Analyze chemical incidents and possible consequences to plant facilities, workers, and the general public.
2. Evaluate effect of chemical hazards and risks of toxicants.
3. Understand the safety aspects and safety audit norms for chemical process plant
4. Analyze fire and explosion hazards.
5. Integrate safety concepts into chemical plant design.

CO-PO-PSO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	1	1
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	1	1
CO5	3	3	2	1	-	-	-	-	-	-	-	-

Unit-I: Introduction:
Safety program, engineering ethics, concept of loss prevention, accident and loss statistics, acceptable risks, nature of accident process, inherent safety. Case studies of major disasters: Chernobyl disaster, Bhopal disaster, recent oil spills.

UNIT – III: Toxicology and Industrial Hygiene:
Toxic materials and their properties, toxicants entry route, dose versus response, models for dose and response curves, threshold limit values, Effects of toxic Agents, Industrial hygiene anticipation and identification, industrial hygiene evaluation, hygiene control.

UNIT – II: Hazard identification and Risk Assessment:
Process hazards checklists, hazard survey, hazards and operability studies (HAZOP), safety reviews, other methods, review of probability theory, event tree, and fault tree, QRA, OSHA and LOPA, Risk assessment procedures.

UNIT – IV: **Fires and explosions:**
Definition of fire, fire triangle, Classification of fires as Class-A, B, C and D, causes of fire and preventive fire and explosion hazards, methods types of explosions, explosion index, explosion-proof equipment and instruments, Fire extinguishers: Portable fire extinguishers applications and their uses..

UNIT – V: Emergency preparation and accident investigation:
On-site and off-site emergency plan and infrastructure, learning from accidents, layered investigation, equipment aiding in diagnosis. Safety audit: Introduction, essentials, requirements, programs and procedures.

Text Books

1. D. A. Crowl and J.F. Louvar, "Chemical Process Safety", Prentice Hall, New Delhi, 2011.
2. Howard H. Fawcett and W. S. Wood, "Safety & Accident prevention in chemical operations", 2nd Ed., John Wiley and Sons Inc, 1982.

Suggested Reading:

1. Coulson and Richadson, "Chemical Engineering Design", 3rd ed., Vol 6, TMH, 1999.
2. Fulekar M.H, "Industrial Hygiene and Chemical Safety", I.K. International Publisher, 2006.
3. Sanders R.E., "Chemical Process Safety: Learning from case Histories", Butterworth-Heinemann (Elsevier) pub, 2005.

Online Resources:

1. Chemical Process Safety, by Prof. Shishir Sinha, Department of Chemical Engineering IIT Roorkee
   https://archive.nptel.ac.in/courses/103/107/103107156/
2. Industrial Safety Engineering, by Prof. Jhareswar Maiti, Department of Industrial & Systems Engineering IIT Kharagpur
   https://archive.nptel.ac.in/courses/110/105/110105094/
3. Safety And Risk Analytics, Prof. Jhareswar Maiti, Department of Industrial & Systems Engineering IIT Kharagpur
   https://archive.nptel.ac.in/courses/110/105/110105160/

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

Department of Mechanical Engineering

List of Open Elective Courses Offered by

S.No	Course Code	Title of the Course
1	22MEO01	Principles of Design Thinking
2	22MEO02	3D Printing
3	22MEO03	Corporate Organizational Behaviour
4	22MEO04	Introduction to Operations Research
5	22MEO05	Research Methodologies and Innovation
6	22MEO06	Principles of Entrepreneurship and startups
7	22MEO07	Futuristic Vehicle Technologies

Mechanical Engineering Department to Other Departments (R22) & (R22A)

22MEO01

PRINCIPLES OF DESIGN THINKING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Nil

COURSE OBJECTIVES: This course aims to

1. Create awareness of design thinking approaches
2. Identify a systematic approach for defining/identifying a problem
3. Create design thinking teams and conduct design thinking sessions collaboratively
4. Apply both critical thinking and design thinking in parallel to solve problems
5. Motivate to apply design thinking concepts to their real life scenarios

COURSE OUTCOMES: After the completion of this course, the student will be able upon completion of this course, the students are able to

1. Understand design thinking and its phases as a tool of innovation
2. Empathize on the needs of the users
3. Define the problems for stimulating ideation
4. Ideate on problems to propose solutions by working as a design thinking team
5. Prototype and test the proposed solutions focusing on local or global societal problems

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	2	2	2	2	2	2	2
CO 2	1	1	2	1	2	2	2	2	1	2	2	2
CO 3	1	1	2	2	1	2	2	2	1	2	2	1
CO 4	2	1	2	2	1	2	2	2	1	2	2	2
CO 5	2	1	2	2	1	2	2	2	1	2	2	2

UNIT – I

Introduction to Engineering & Thinking: Engineering for social and economic development; impact of science/engineering. Thinking and behaviour; Types of thinking – Linear thinking, lateral thinking, systems thinking, design thinking.

Introduction to Design Thinking: Importance of Design Thinking & Human centric approach – Phases in design thinking process, five-stage model as iterative method, applications of design thinking in various domains.

UNIT – II

Empathize phase: Understanding the unique needs of the user, empathize with the users, steps in empathize phase, developing empathy towards people, assuming a beginner's mind-set (what? why?), steps in immersion activity, body storming; Case studies.

UNIT – III

Define phase: Define the problem and interpret the result, analysis and synthesis, Personas – Four different perspectives on Personas, steps to creating personas, problem statement, affinity diagrams, empathy mapping; Point of View – "How might we" questions, Why-how laddering; Case studies.

UNIT – IV

Ideation phase: What is ideation, need, uses, ideation methods; Brainstorming, rules for brainstorming; Mind maps, guidelines to create mind maps; Ideation games; Six Thinking Hats; Doodling, use of doodling in expressing creative ideas; Case studies.

UNIT – V

Prototyping phase: Types of prototyping, guidelines for prototyping, storytelling, characteristics of good stories, reaching users through stories, importance of prototyping in design thinking; Value proposition, guidelines to write value proposition; Case studies.

Testing phase: Necessity to test, user feedback, conducting a user test, guidelines for planning a test, how to test, desirable, feasible and viable solutions, iterate phase.

Text Books:

1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires, 1st Edition, HarperCollins, 2009.
2. Michael Luchs, Scott Swan, Abbie Griffin, Design thinking: New product development essentials from the PDMA. John Wiley & Sons, 2015.
3. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solv ing, Penguin Random House India Private Limited, 2020.

Suggested Reading:

1. Jeanne Liedtka, Andrew King, Kevin Bennett, Solving problems with design thinking: Ten stories of what works. Columbia University Press, 2013.
2. Bala Ramadurai, Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Edition 1, 2020.

22MEO02

3D PRINTING

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

COURSE OBJECTIVES: This course aims to

1. Make students understand the basic concept of digital manufacturing.
2. Teach different processes involved in digital fabrication of products.
3. Demonstrate the STL file generation and manipulations.
4. Demonstrate various post processing techniques.
5. Demonstrate the applications of RP in different fields of engineering

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completion of this course, students will be able to

1. Understand the concept of 3D printing processes, advantages, and limitations.
2. Evaluate real-life scenarios and recommend the appropriate 3D printing technology.
3. Analyze various pre-processing and post processing techniques.
4. Identify components and construct basic 3D printer.
5. Explain current and emerging 3D printing technologies in diversified applications

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	-	3	2	2	2	-	2	1	2
CO 2	2	2	3	2	2	3	2	2	2	2	2	2
CO 3	2	1	1	2	2	2	2	2	1	1	1	1
CO 4	2	2	2	1	2	2	2	2	2	2	2	2
CO 5	2	1	2	1	1	2	2	2	-	1	-	1

UNIT-I

Introduction to 3D Printing: Introduction to 3D printing, evolution, distinction between 3D printing and CNC machining. Design considerations: Materials, size, resolution, mass customization. additive vs. subtractive manufacturing, its advantages and limitations

UNIT-II

Photo polymerization processes: Photo polymerization, Stereolithography Apparatus (SLA), Applications, advantages and disadvantages.
Powder bed fusion processes: Introduction, Selective laser Sintering (SLS), Materials, Applications, advantage and disadvantages.
Extrusionbased systems: Fused deposition modeling (FDM), principles, Materials, Process Benefits and Drawbacks.
Laminated Object Manufacturing (LOM), Principles, Materials, Process Benefits and Drawbacks.

Material Jetting AM Processes: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Process

UNIT-III

Pre processing in AM: Modeling and viewing 3D scanning; Model preparation – STL conversion, STL error diagnostics, STL file Repairs, generic solution, slicing, newly proposed file formats.
Post processing in AM: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements usingnon thermal and thermal techniques.

UNIT-IV

Construction of basic 3D printer: Construction of 3D printing machine – axes, linear motion guideways, ball screws, motors, bearings, encoders, process chamber, safety interlocks, sensors.

UNIT-V

Applications of AM: Application in construction and architectural engineering, aerospace industry, automotive industry, jewelry industry, coin industry. medical and bioengineering applications: planning and simulation of complex surgery, forensic science.

Text Books:

1. Gibson, DW. Rosen and B.Stucker; Additive manufacturing methodologies: Rapid prototyping todirect digital manufacturing, Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, 3D printing and additive manufacturing: principles and application, 4 th edition of rapid prototyping, World scientific publishing company, 2014.
3. P.K. Venuvinod, Rapid prototyping – Laser based and other technologies, Kluwer, 2004.

Suggested Reading:

1. Jacob, Paul, Rapid tooling: Technologies and industrial applications, Taylor & Francis Group, 2000.
2. Alain Bernard, Georges Taillandier, Additive Manufacturing, Wiley, 2014

22MEO03

CORPORATE ORGANIZATIONAL BEHAVIOUR

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil.

COURSE OBJECTIVES: This course aims to

1. Define the basic corporate organizational behaviour principles and analyze how these influence behaviour in the work place.
2. Provide knowledge on different organizational structures; and concepts of culture, climate and organizational development and make the students familiarize with individual behavior.
3. Discuss the theories of Motivation and Leadership.
4. Describe the interpersonal and their intrapersonal reactions within the context of the group and also demonstrate effective communication and decision making skills in small group settings
5. Describe the basic concepts of Power, Politics, Conflict and Negotiations.

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completion of this course, students will be able to

1. Understand the Corporate Organizational Behaviour principles and practices.
2. Compare the various corporate organizational designs and structures enabling organizational development.
3. Apply motivational theories and leadership styles in resolving employee‘s problems and decision making processes.
4. Analyze the behaviour, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.
5. Understand the aspects of power, politics, and apply the skills needed to resolve organizational conflicts.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	2	1	1	1	-	1	1	1	1	1
CO 2	3	2	3	2	2	1	-	1	1	-	1	2
CO 3	3	2	2	3	2	-	-	-	2	-	-	2
CO 4	3	2	3	2	2	-	-	-	1	-	2	3
CO 5	3	2	2	1	2	-	-	-	1	-	-	1

UNIT –I

Introduction: Organizational Behaviour, Nature and Levels of Organizational Behaviour, Role of Individuals in an Organization, Individual Differences: Personality and Ability, The Big Five Personality Traits, Perception and the Nature of Perception, Characteristics of the Perceiver, Target and Situation, Perceptual Problems.

UNIT – II

Organization Structure: Organizational Designs and Structures, Traditional and Contemporary Organizational Designs, Corporate Organization: Definition and Structure, Organizational Culture and Ethical Behaviour, Creating an Ethical Culture, Organization Change and Development.

UNIT – III

Motivation and Leadership: Motivation, Nature of Motivation, Motivation Process, Early and Contemporary Theories of Motivation, Leadership: Importance and Functions, Early and Contemporary Approaches to Leadership.

UNIT – IV

Group Dynamics: Groups and Interpersonal Dynamics, Nature of Groups, Types of Groups, Stages of Group Development, Turning Groups into Effective Teams, **Communication**: The Nature and Importance of Communication in Organizations, Communication Process, Barriers to Communication, Overcoming Barriers to Effective Communication.

UNIT – V

Power, Politics, Conflict and Negotiations: Power: The Nature and Types of Power, Sources of Individual, Functional and Divisional Power, Politics and Political Behaviour, Managing Political Behaviour, Organizational Conflict: Nature, Common Forms and Causes of Conflict, Pondy‘s model of organizational conflict, Conflict Resolution Strategies, Negotiations in Organizations.

Text Books:

1. Jennifer George and Gareth Jones, Understanding and Managing Organizational Behaviour, Pearson Education Inc., 2012.
2. Jon L Pierce and Donald G. Gardner, Management and Organizational behaviour, Cengage Learning India (P) Limited, 2001.
3. Richard Pettinger, Organizational Behaviour, Routledge, 2010

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones, Management and Organizational Behaviour, Pearson Education Inc., 2009.
2. John Schermerhorn, Jr., James G. Hunt and Richard N. Osborn, Organizational Behaviour, 10th edition, Wiley India Edition, 2009.

22MEO04

INTRODUCTION TO OPERATIONS RESEARCH

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Knowledge on basics of Mathematics

COURSE OBJECTIVES: This course aims to

1. Make the students come to know the formulation of LPP models.
2. Familiarize the students with the Algorithms of Graphical and Simplex Methods.
3. Make the students understand the Transportation and Assignment techniques.
4. Familiarize the students with the procedure of Project Management along with CPM and PERTtechniques.
5. Make the students understand the concepts of sequencing and queuing theory

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completion of this course, the students are able to

1. Understand the concepts of linear programming problems and Solve
2. Solve the given transportation problem.
3. Develop optimum pair of operations and resources by using Assignment technique.
4. Analyze project management techniques like CPM and PERT to plan and execute projectssuccessfully.
5. Apply sequencing and queuing theory concepts for industry applications.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	1	-	1	-	-	1	1	-	-	1
CO 2	2	1	1	-	1	-	-	1	-	-	-	1
CO 3	1	1	1	-	-	2	-	-	-	-	2	1
CO 4	3	-	-	-	-	-	-	1	-	-	-	2
CO 5	2	1	1	-	-	2	1	-	1	-	2	1

UNIT-I

Introduction: Definition and scope of operations research.

Linear programming: Introduction, formulation of linear programming problems, graphical method of solving LP problem, simplex method, degeneracy in simplex, duality in simplex.

UNIT-II

Transportation models: Finding an initial feasible solution north west corner method, least cost method, Vogel's approximation method, finding the optimal solution, special cases in transportation problems unbalanced transportation problem, degeneracy in transportation, profit maximization in transportation.

UNIT-III

Assignment techniques: Introduction, Hungarian technique of assignment techniques, unbalanced problems, problems with restrictions, maximization in assignment problems, travelling salesman problems.

UNIT-IV

Project management: Definition, procedure and objectives of project management, differences between PERT and CPM, rules for drawing network diagram, scheduling the activities, Fulkerson's rule, earliestand latest times, determination of ES and EF times in forward path, LS & LF times in backward path, determination of critical path, duration of the project, free float, independent float and total float, crashing of network.

UNIT-V

Sequencing models: Introduction, General assumptions, processing 'n'jobs through two machines, processing 'n' jobs through three machines.

Queuing theory: Introduction, Kendall's notation, single channel Poisson arrivalsexponential service times.

Text Books:

1. Hamdy A. Taha, Operations ResearchAn Introduction, 10th edition, Pearson education India,2017.
2. S.D. Sharma, Operations Research, Kedarnath, Ramnath& Co., Meerut,2009.
3. V.K. Kapoor, Operations Research, S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. R. PaneerSelvam, Operations Research, 2nd edition, PHI Learning Pvt. Ltd., New Delhi,2008.
2. Nita H. Shah, Ravi M. Gor, HardikSoni, Operations Research, PHI Learning Private Limited,2013.

22MEO05

RESEARCH METHODOLOGIES AND INNOVATION

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

COURSE OBJECTIVES: This course aims to

1. Make the students to formulate the research problem
2. Identify various sources for literature review and data collection.
3. Prepare the research design
4. Equip the students with good methods to analyze the collected data
5. Introduce students to the concepts of innovation

COURSE OUTCOMES: After the completion of this course, the student will be

1. Define research problem
2. Review and assess the quality of literature from various sources.
3. Understand and develop various research designs.
4. Collect and analyze the data using statistical techniques.
5. Apply creative thinking and innovative skills.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1	1	-	1	-	-	1	2	2	2
CO 2	-	2	1	2	1	1	-	1	1	3	2	2
CO 3	1	2	3	2	2	1	-	-	1	2	-	1
CO 4	2	2	-	3	2	-	-	-	-	2	1	1
CO 5	2	2	3	2	3	1	-	-	-	-	-	3

UNIT – I:

Research Methodology: Objectives, Motivation and Significance of Research, Types of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information Primary, Secondary and tertiary, Assessment of Quality of Journals and Articles, Information through Internet

Research writing: Format of the Research report, Writing a Synopsis, Dissertation, Research Proposal and Research Report

UNIT – III

Research Design: Meaning and Need of Research Design, Terminology used in Research Design, Features of a Good Research Design, Formulation of hypothesis, **O**perationalizing the research question, Different Research Designs – exploratory, descriptive, diagnostic and hypothesistesting research studies, Basic Principles of Experimental Design, Steps in Sample design

UNIT – IV

Data Collection and Analysis: Collection of primary dataObservation, Interview and Questionnaire methods, Secondary data, Measures of central tendency, Measures of dispersion, Measures of asymmetry, Important parametric testsz, t, F, ChiSquare, ANOVA significance.

UNIT – V

Innovation: Creativity, Innovation and its difference, Blocks for creativity and innovation, overcoming obstacles, Examples of innovation, Being innovative, Steps for Innovation, right climate for innovation, Design led innovation, Gross root innovation, Frugal and flexible approach to innovation.

Text Books:

1. C.R Kothari, "Research Methodology Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008

Suggested Reading:

1. Vijay Upagade and Aravind Shende, "Research Methodology", S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, "Research Methodology and Quantitative methods", BS Publications, Hyderabad, 2012.
3. JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.

Online Resources:

1. https://archive.nptel.ac.in/courses/127/106/127106227/
2. https://archive.nptel.ac.in/courses/107/101/107101088/

22MEO06

PRINCIPLES OF ENTREPRENEURSHIP AND STARTUPS

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

COURSE OBJECTIVES: This course aims to

1. Impart basic concepts and procedure of idea generation.
2. Familiarize the nature of industry and related opportunities and challenges.
3. Familiarize with elements of business plan and its procedure.
4. Learn the project management and its techniques.
5. Know the behavioral issues and time management.

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completion of this course, the students will be able to

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	1	1	1	2	2	2	1	1	1	1
CO 2	1	1	1	1	1	2	2	2	2	2	3	1
CO 3	1	1	1	2	2	2	2	2	2	2	3	1
CO 4	2	1	1	2	2	2	2	2	1	2	3	1
CO 5	1	-	1	1	1	-	2	2	1	1	1	1

UNIT - I

Entrepreneurship: Definition, Characteristics of an Entrepreneur, Functions of Entrepreneurs, Entrepreneur vs. Intrapreneur, First Generation Entrepreneur, Women Entrepreneurship, Ideas and their Sources, Conception and Evaluation of Ideas.

Behavioral Aspects of Entrepreneurs: Personality: Determinants, Attributes and Models, Leadership: Concepts and Models, Values and Attitudes, Motivation Aspects.

UNIT - II

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic Growth, Small Scale Industry in India, objectives, Linkage among Small, Medium and Heavy Industries, Types of Enterprises, Corporate Social Responsibility.

UNIT - III

Business Plan: Introduction, Elements of Business Plan and its salient features, Business Model Canvas, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility Studies, Executive Summary.

UNIT - IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management.
Time Management: Approaches of Time Management, their strengths and weaknesses. Time Management Matrix, Urgency Addiction.

UNIT - V

Startup: Definition, Startup Ecosystem, Startup Incubator, Need and Importance of Startups and Incubation Centers. Sources of Finance and Incentives for Startups. Innovation, Creativity, Intellectual Property in Entrepreneurial Journey. Business firm Registration Process in INDIA.

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw- Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5th edition, Tata Mc Graw Hill Publishing Company. Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

22MEO07

FUTURISTIC VEHICLE TECHNOLOGIES

Instruction	3L	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Prerequisite: Nil

COURSE OBJECTIVES: This course aims to

1. Learn about the layout and arrangement of principal parts of an Automobile.
2. Learn about the techniques of pollution control in conventional automobiles.
3. Learn about the different types of alternative energy sources for automobiles.
4. Understand the working of different types of transmission and braking systems.
5. Learn about the different types of suspension and steering systems.

COURSE OUTCOMES: After the completion of this course, the student will be able Upon completion of this course, the students will be able to

1. Identify the principal parts of a conventional automobile and its layout.
2. Understand the various supporting systems of a conventional automobile and the need for pollution control.
3. Understand the importance of alternative power trains for pollution control.
4. Analyze the functioning of transmission and braking systems.
5. Understand the various suspension and steering systems.

CO-PO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1	1	-	1	-	1	-	1	2	1	2
CO 2	2	1	1	-	1	-	1	-	1	2	1	3
CO 3	2	2	1	-	1	-	1	-	1	2	1	3
CO 4	2	2	1	-	1	-	1	-	1	2	1	2
CO 5	2	2	1	-	1	2	2	1	1	2	1	3

UNIT - I

Conventional Automobile: Chassis Layout, Monocoque Chassis, Four-Stroke Internal Combustion Engine, Gasoline Direct Injection (GDI) Engine, Common Rail Direct Injection (CRDI) Engine, Turbocharger.

UNIT - II

Wet Sump Lubricating System, Electronic Ignition System, Engine Cooling System, Automobile Air-Conditioning System.

Pollution Control: Emissions from Automobiles, Euro norms and Bharat Norms - Bharat Stage Emission Standards 6, Catalytic Converter, Selective Catalytic Reduction (SCR).

UNIT – III

Alternative Power Trains: Need for and Types of Alternative Power Trains.

Electric Vehicle (EV) Technology: Architecture of an EV, Types of EV, Battery Electric Vehicle (BEV), Architecture of a Hydrogen Fuel Cell Electric Vehicle (FCEV).

Hybrid Vehicle Technology: Architecture of Hybrid Electric Vehicle (HEV) and Plug-in Hybrid Electric Vehicle (PHEV).

An introduction to Flexible Fuel Vehicles (FFVs).

UNIT – IV

Power Train: Single Plate Clutch, Manual Transmission (Synchromesh Transmission), Automatic Transmission, Four-wheel drive system, All-wheel drive system.
Braking System: Disc and Drum Brakes, Description and operation of Hydraulic Braking System, Hand brake linkage,Anti-Lock Braking System (ABS), Electronic Brakeforce Distribution (EBD), An overview on Advanced Driver-Assistance System (ADAS).

UNIT – V

Suspension System: Objectives of a Suspension system, Independent Suspension System, MacPherson Strut Suspension, Double Wishbone Suspension.
Steering System: Rack and Pinion Steering Gear Box, Electronic Power Steering System, Wheel Balancing, Wheel Alignment, Tyre Specification, Tyre Wear and Causes.

Text Books:

1. R. K. Rajput, A Textbook of Automobile Engineering, 2nd edition, Laxmi Publications Pvt Ltd, 2007
2. Kirpal Singh, Automobile Engineering, Vol I and II",12th edition, Standard Publishers, 2011
3. P.L. Kohli, Automotive Electrical Equipment, Tata McGraw Hill, 1985.

Suggested Reading:

1. S. Srinivasan, Automotive Mechanics, 2nd edition, Tata Mc Graw Hill, 2003
2. William H. Crouse, Donald L. Anglin, "Automotive Mechanics", 10th edition, Tata Mc Graw Hill, 2007.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF MATHEMATICS

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	22MTO01	Fundamentals of Quantum Computing
2.	22MTO02	Optimization Techniques
3.	22MTO03	Biostatistics

22MTO01

FUNDAMENTAL OF QUANTUM COMPUTING

Instruction	3L Hours per week
Duration of semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To learn basic mathematical Concept for Quantum Computing.
2. To understand the evaluation of the quantum bits. & building blocks.
3. To know the basics of Quantum logic gates and circuits.
4. To learn Quantum Algorithms by various Techniques.
5. To introduce fundamental of Quantum cryptography

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Compute basic mathematical operations on Quantum bits.
2. Solve Quantum operations.
3. Apply quantum Logical gates and circuits.
4. Implement quantum algorithm.
5. Implement Cryptography in Quantum.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	2	2	-	-	-	-	-	-	-	-	-	-
CO 3	2	2	1	-	-	-	-	-	-	-	-	-
CO 4	2	2	2	2	-	-	-	-	-	2	2	-
CO 5	2	2	2	2	-	-	-	-	-	2	2	-

UNIT-I: Math Foundation for Quantum Computing:

Introduction to Vector Space, Subspaces, Linear Independent and dependent Vectors, Basis and Finite Dimensions. Orthogonality of Vectors, Inner product and Outer product of Hilbert Spaces. Unitary operators and projections, Eigenvalues and Eigenvectors. Introduction to GCD and Congruence.

UNIT-II: Introduction to Quantum Computing:

Quantum Mechanics (Huygens wave theory, Photo electric effect De-Broglie hypothesis and Heisenberg'suncertainty Principle), Origin of Quantum Computing, Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave). Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product.

UNIT-III: Quantum Logical gates and Circuits:

Single Qubit gates: Pauli, Hadamard, Phase shift, Controlled gates: C-NOT, CCNOT. Quantum Entanglement, Quantum Teleportation (EPR Model) and Bell State, Introduction to Discrete Fourier transform.

UNIT-IV: Quantum Algorithms:
Quantum Fourier Transform, Quantum Phase estimation, Major Algorithms: Shor's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm.

UNIT-V: **Quantum Cryptography:**

Public and private key Cryptography, Quantum key distribution, Quantum Cryptography, Experimental implementation of quantum cryptography protocols.

Text Books:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley .

22MTO02

OPTIMIZATION TECHNIQUES

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	60 Marks
Continuous Internal Evaluation	40 Marks
Credits	3

Pre-requisites: Mathematical Foundation for Data Science and Security.

COURSE OBJECTIVES: This course aims to The objectives of this course are

1. To identify and develop optimization techniques from the verbal description of real system.
2. To learn different techniques to get optimum solution LPP.
3. To understand the Mathematical representations that is needed to solve optimization problem.
4. To analyze the results of the different real-world problems.
5. To construct network and find critical path using network scheduling technique.

COURSE OUTCOMES: After the completion of this course, the student will be able

1. Calculate the optimum values for given objective function by LPP.
2. Solve the solution for maximize the profit with minimum cost by Transportation problem.
3. Determine the optimum feasible solution for assignment and travelling salesman problems andcomputing the optimal solution for Job sequencing models.
4. Compute the optimum values for given objective function by IPP and optimal strategy for games.
5. Identify critical path using network scheduling.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	2
CO2	3	3	2	1	-	-	-	-	-	-	-	2
CO3	3	3	2	1	-	-	-	-	-	-	-	2
CO4	3	3	2	1	-	-	-	-	-	-	-	2
CO5	3	3	2	1	-	-	-	-	-	-	-	2

UNIT - I

Introduction to Operations Research: Basics definitions, objectives, models, application and limitations. Linear Programming (LP) - Mathematical Formulation of LP problem, Graphical Method, Some Exceptional Cases, Simplex Method - Introduction, computational procedure, artificial variables technique - big-M method and 2-phase method.

UNIT - II

Introduction, Mathematical Formulation of transportation Problem, Balanced / Unbalanced, Minimization / Maximization, Determination of the initial basic feasible solution using (i) North-West Corner Rule (ii) Least cost method & (iii) Vogel's approximation method for balanced & unbalanced transportation problems. Optimality Test & obtaining of optimal solution (Considering per unit transportation cost) using MODI method and steppingstone method.

UNIT - III

Introduction, Mathematical Formulation of Assignment Problem, Hungarian method for optimal solution,Solving unbalanced problem, Traveling salesman problem, Sequencing models, Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

UNIT - IV

Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's All-IPP Method, All IPP Algorithm, Branch and Bound Technique Game and strategies: Introduction, Game with maximin-minimax principle (Pure Strategies), Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

UNIT - V

Construction of Network – Rules & Precautions, C.P.M. & P.E.R.T. Networks, Obtaining of Critical Path, Time estimates for activities, Probability of completion of project, Determination of floats (total, free, independent).

Text Books:

1. Kanti Swarup, P. K. Gupta, Man Mohan, "Operations Research", Sultan Chand Publications, 2010.
2. R. Pannerselvam, "Operations Research", PHI, 2nd Edition, 2016.

Suggested Reading:

1. Deb K. "Optimization for Engineering Design Algorithms and Examples", PHI, 2000.
2. Arora J. "Introduction to Optimization Design", Elsevier Academic Press, New Delhi, 2004.
3. Saravanan R. "Manufacturing Optimization through Intelligent Techniques", Taylor & Francis (CRC Press), 2006.
4. Hardley G. "Linear Programming", Narosa Book Distributors Private Ltd., 2002.

Online Resources:

1. https://nptel.ac.in/courses/111105039
2. https://nptel.ac.in/courses/105108127

22MTO03

Bio-Statistics
(For Bio-Technology only)

Instruction:	3L Periods per week
Duration:	3 Hours
End Exam:	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES: This course aims to

1. Learn the language and core concepts of Statistics
2. Understand basic principles of Random variable and probability function
3. Learn the procedure to fit the random phenomenon using Probability distributions
4. Understand the concept of testing of hypothesis.
5. Learn the methods for analyzing data using Analysis of Variance.

COURSE OUTCOMES: After the completion of this course, the student will be able On the successful completion of this course, the student shall be able to

1. Use basic counting techniques to compute probability
2. Compute conditional probabilities using Bayes Theorem
3. Use the probability distributions for fitting of random behavior
4. Find confidence intervals for parameter estimation
5. Setup one way & two way classification for analyzing the data

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	-	-	-	-	-	-	-	2
CO2	2	2	1	1	-	-	-	-	-	-	-	2
CO3	2	2	1	1	-	-	-	-	-	-	-	2
CO4	2	2	1	1	-	-	-	-	-	-	-	2
CO5	2	2	1	1	-	-	-	-	-	-	-	2

UNIT-I: BASIC STATISTICS: Types of data – Methods of collection of data-Graphical representation of data-Histogram-Boxplot-Pie chart. Frequency distribution, Measures of central tendencies, Measures of dispersion, Skewness, Bowley's coefficient, Karl Pearson's coefficient of skewness, Kurtosis, Correlation-Lines of regression, properties of correlation coefficients, applications of Bio-technology.

UNIT-II: RANDOM VARIABLES: Basic theorems of Probability, conditional probability, Baye's theorem, Random variable- types of Random variable-probability mass function-probability density functions-Mathematical Expectation, Variance, Co-Variance and their properties, Moments about a point and Moments about the Mean.

UNIT-III: PROBABILITY DISTRIBUTIONS: Discrete probability distribution: Binomial Distribution,, Mean, Variance, MGF, CGF, Poisson distribution, Mean, Variance, MGF, CGF, fitting of Poisson distribution. Continuous Probability Distributions: Normal distribution, Standard

Normal random variable Expectation, Variance, MGF , CGF, Properties of Normal Curve and Areas under Normal curve.

UNIT- IV: LARGE SAMPLE TEST: Test of significance, null and alternative hypotheses, Errors in sampling, level of significance, critical region, one tailed and two tailed tests.. Large sample test: Test of significance for single proportion, difference of proportions, single mean and difference of means. Difference of Standard Deviations.

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UNIT-V: **SMALL SAMPLE TEST**: Test of significance, t-Test for single mean, differences of Means. F- test for equality of two population variances , $\chi^2 - test$,Goodness of fit test, test of independent of attributes-r x c-tables, Analysis of variance, Assumptions for ANOVA test, One way Classification ,Two Way Classification.

Text Books:

1. S.C.Gupta and Dr.V.K.Kapor,"Fundamentals of Mathematical Statistics: A Modern Approach", tenth edition, Publishers: Sultan Chand & Sons,2005
2. A.K.Sharma ,"Text Book of Bio-Statistics"; Discovery Publishing House, 2005.

Suggested Reading:

3. Mahajan, "Methods in Bio-Statistics",Japee Brothers Publishers, 2002.
4. P.S.S Sunder Rao and J.Richard,"Introduction to Bio-Statistics and Research Methods" fifth edition, PHI Learning Pvt. Ltd.2012.
5. S.C.Gupta and Dr.V.K.Kapoor, "Fundamentals of Applied Statistics", tenth edition, Publishers: Sultan Chand & Sons,2005

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF PHYICS

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	22PHO01	History of Science & Technology

22PHO01

HISTORY OF SCIENCE AND TECHNOLOGY
(Open Elective – III)

Instruction	3	Hours per week
Duration of SEE	3	Hours
SEE	60	Marks
CIE	40	Marks
Credits	3	

Course Objectives : The objectives of the course is to make the student

1. Gain the knowledge about origin of science in the Stone Age and its progress during Antiquity period.
2. Familiar with scientific views in the Medieval period and during the Industrial revolution.
3. Aware of modern scientific developments from 19th century onwards.

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

1. Demonstrate the process of beginning of science and civilization, knowledge acquisition and philosophical approach of science and its advancements in the Stone Ages and Antiquity period.
2. Illustrate the advancements in science and technology in the medieval period across Asia and Arab countries and decline and revival of science in Europe.
3. Explain the scientific approach and its advances of the Europeans and how the role of engineer during the industrial revolution and the major advancements.
4. Make use of the advancements in the field of science and technology by adopting new philosophies of 19th and first half of 20th century in finding ethical solutions to the societal problems.
5. Interpret the changes in specializations of science and the technology and build the relation between information and society from second half of 20th century onwards.

Course Articulation Matrix:

Program Outcomes (POs)												
Cos	1	2	3	4	5	6	7	8	9	10	11	12
1	3	1	1	1	1	2	2	1	1	2	1	2
2	3	1	2	1	2	2	2	1	2	2	2	2
3	2	2	1	1	1	1	1	1	1	2	1	2
4	3	2	2	2	2	2	2	1	1	2	1	2
5	3	2	2	2	2	1	2	2	1	2	1	2
6												

UNIT-1

Science – The Beginning (through 599 BCE): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions, Civilizations, Major advance.

Science in Antiquity (600 BCE – 529 CE) : Philosophy- a precursor to science, Hellenistic world and the Roman Empire, other cultures of the period, Major advances.

UNIT-II

Medieval Science (530 CE – 1452 CE) : The decline of science in Europe, Science in China, Science and mathematics in India, Arab Science, Revival of science in Europe, Technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 CE-1659 CE) : Renaissance, Scientific Revolution, Technology, Major advances.

UNIT-III

Scientific Method: Measurement and Communication (1660 CE-1734 CE): Europe domination, the scientific method, Major advances.

The Industrial Revolution (1735 CE-1819 CE) : Industrial Revolution, Rise of the engineer, Major Advances.

UNIT-IV

Science and Technology in the 19th Century (1820 CE - 1894 CE) : Philosophical basis of 19th century science, Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 CE - 1945 CE): The growth of 20th century science, Ne philosophies, Quantum reality, Energy sources, Electricity : a revolution in technology, Major advances.

UNIT-V

Big Science and the Post-Industrial Society (1946 CE- 1972 CE) : Big science, specialization and changing categories, technology changes society, Major advances.

The Information Age: (1973 CE-2015 CE): Information and society, Globalization, The post-industrial society, Problems of the Information Age, Major Advances.

Text Books:

1. Bryan Bunch and Alexander Hellemans, "The History of Science and Technology", Houghton Miffin Company (New York), 2004
2. JD Bernal, "Science in History", 4 Volumes, Eklavya Publishers, 2012

Suggested Readings:

1. "The 100 Most Influential Scientists of All Time", Edited by Kara Rogers, Britannica Educational Publishing, 2010
2. Alberto Hemandez, "A Visual History of Science and Technology", The Rosen Publishing Group, 2016.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF ENGLISH

Open Elective Courses

S. No	COURSE CODE	COURSE NAME
1.	**22EGO01**	Technical Writing Skills
2.	**22EGO02**	Gender Sensitization
3.	**22EGO03**	Indian Traditional Knowledge

22EGO01

TECHNICAL WRITING SKILLS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Language proficiency and the ability to simplify complex technical concepts for a diverse audience.

COURSE OBJECTIVES: This course aims to

The course will introduce the students to:

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:

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

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words.
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	1	1	-	1	1	2	3	3	2	3
CO 2	-	1	-	1	-	-	-	1	2	2	1	2
CO 3	-	2	-	2	-	1	1	1	2	3	2	2
CO 4	2	2	1	3	-	2	2	1	3	3	2	2
CO 5	1	1	1	1	-	1	1	1	3	3	2	2

Unit - I

Communication – Nature and process.

Channels of Communication – Downward, upward and horizontal communication. Barriers to communication.

Technical Communication – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

Unit II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

Unit III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters.

Technical Articles: Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

Unit IV

Technical Reports: Types, significance, structure, style and writing of reports. Routine reports, Project reports.

Technical Proposals: Definition, types, characteristics, structure and significance.

Unit V

Mechanics of Meetings: Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

Technical Presentations: Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Textbooks:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communications-Principles and Practice", Oxford University Press, Second Edition, 2012.
2. M Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading:

1. Kavita Tyagi & Padma Misra, "Basic Technical Communication", PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, "Business Correspondence and Report Writing", Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

22EGO02

GENDER SENSITIZATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: No specific prerequisite is required.

Course Objectives This course will introduce the students to:

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

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

1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways in which gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	1	-	-	2	2	1	1	-	-	1
CO 2	-	-	1	-	-	2	2	1	1	-	-	1
CO 3	-	-	1	-	-	2	2	2	2	1	1	1
CO 4	-	-	1	-	-	3	2	2	2	1	1	1
CO 5	-	-	1	-	-	2	2	2	3	1	1	1

UNIT – I

Understanding Gender:

Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1)

Socialization: Making Women, Making Men (*Towards a World of Equals*: Unit -2)

Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II
Gender and Biology:
Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)
Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10)
Two or Many? Struggles with Discrimination.

UNIT – III
Gender andLabour:
Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages andConditions of Work.

UNIT-IV
Issues of Violence
Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*
Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:
New Forums for Justice.
Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face ofViolence.

UNIT – V
Gender: Co - Existence
Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

Textbook:
1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu"Towards a World of Equals: A Bilingual Textbook on Gender"**,** Telugu Akademi, Hyderabad,2015.

Suggested Reading:
1. Menon, Nivedita. "Seeing like a Feminist", Zubaan-Penguin Books, New Delhi, 2012.
2. AbdulaliSohaila,"I Fought For My Life…and Won", Available online at:
http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:
1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fieldsof English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

22EGO03

INDIAN TRADITIONAL KNOWLEDGE

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Indian Culture.

COURSE OBJECTIVES: This course aims to

1. To get a knowledge in Indian Culture.
2. To know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Course Outcomes:

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval, and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

CO-PO-PSO Articulation Matrix

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	2	1	1	2	3	3	2	2	1	2
CO 2	1	1	2	1	1	2	3	3	2	2	1	2
CO 3	1	1	2	1	1	2	3	3	2	2	1	2
CO 4	1	1	2	1	1	2	3	3	2	2	1	2
CO 5	1	3	2	1	1	2	3	3	2	2	2	3

UNIT I

Culture and Civilization: Culture, Civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian Cuisine, Martial arts.

UNIT II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient. Medieval and modern India. Concepts of Sciences in Indian Knowledge Systems.

UNIT III

Linguistic Wealth: Indian languages and Literature: The role of Sanskrit, Morphology and brevity of Sanskrit, Concepts of NLP in IKS. Paleography, Fundamentals of Vedic Mathematics, Significance of scriptures to current society, Indian semantics and lexicography, Darshanas.

UNIT IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, introduction to Mayamatam, Iron and Steel technology, Use of metals in medicinal preparations.

UNIT-V

Science and Logic: Heliocentric system, Sulbasutras, Katapayadi, Engineering in Vedas, Adaptability of Sanskrit in Computer languages, Related commands Hindu calendar, 6 Pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka- Induction and deduction, Ayurvedic biology, Definition of health.

Text Books:

1. B. Madhavan, Nagendra Pavana, Vinayak Rajat Bhat, "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning, June 2022.
2. Kapil Kapoor, "Text and Interpretation: The Indian Tradition", D K Print World Ltd., 2005.
3. Samskrita Bharati, "Science in Sanskrit",2017.
4. Satya Prakash, "Founders of sciences in Ancient India", Govindram Hasanand, 1986.

Suggested Reading:

1. Brajendranath Seal**, "**The Positive Sciences of the Ancient Hindus", Motilal Banarasidass, 2016.
2. Kancha Ilaiah, "Turning the Pot, Tilling the Land: Dignity of Labour in Our Times", Navayana, 2019.
3. Balram Singh and others, "Science & Technology in Ancient Indian Texts", D.K. Print World Ltd, 1st edition, 2012.
4. Smt. Kalpama Paranjepe, "Ancient Indian insight and Modern Science"**,** Bhandarkar Oriental Research Institute, 1996.
5. Pradeep Parihar, "Vedic World and Ancient Science", World House Book Publishing, 2021.