SCHEME OF INSTRUCTION AND SYLLABI (R-20)
OF
B.E. I & II SEMESTERS
IN
ARTIFICIAL INTELLIGENCE
& MACHINE LEARNING
(For the batch admitted in 2022-23)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
(An Autonomous Institution)
Affiliated to Osmania University
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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)
DEPARTMENT OF AI&ML
PROGRAMME: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

INSTITUTE VISION AND MISSION:
Vision: To be a Centre of Excellence in Technical Education and Research
Mission: To address the emerging needs through quality technical education and advanced research

DEPARTMENT VISION AND MISSION:
Vision: To be in the frontiers of Computer Science and Engineering with academic excellence andResearch
Mission: The mission of Computer Science and Engineering Department is to:
1. Educate students with the best practices of Computer Science by integrating the latest researchinto the curriculum
2. Develop professionals with sound knowledge in theory and practice of Computer Science andEngineering
3. Facilitate the development of academia-industry collaboration and societal outreach programs
4. Prepare students for full and ethical participation in a diverse society and encourage lifelonglearning

PROGRAM EDUCATION OBJECTIVES (PEOS):
1. Graduate will practice their career in the areas of application software development, AI&ML, Data Analytics and Internet of Things.
2. Graduate will exhibit professional ethics and moral value with capability of working as an individual and as a team contributing towards the needs of industry and society.
3. Graduate will become a successful entrepreneur with innovative ideas and research contribution or pursue higher studies.

PROGRAM SPECIFIC OUTCOMES (PSOS): At the end of the program,

ABOUT THE DEPARTMENT:

Department of CSE was established in the year 1985 with an intake of 20 students in UG program, gradually increased to 30 in 1991, 40 in 1993, 60 in 1994, 120 in 2000, 180 in 2013.Currently the department offers three UG programs BE (CSE), BE CSE (AI& ML), BE CSE (Internet of Things & Cyber Security including Block Chain Technology) with an intake of 300. M.Tech. CSE was started inthe year 2002 with an intake of 18 and increased to 36 in 2011. The intellectual ambiance in CSE Department is conducive to the holistic development of the students.

BE-CSE program was first accredited by the NBA (AICTE) during 1998 with 'A' grade for 3 years , and further accredited during 2004, 2008, 2013 and 2017 consecutively. CSE department is a recognized Research center under Osmania University. CSE Faculty and students as part of their scholarly activities have published patents. Further both faculty and students have research publications in journals of international and national repute. In addition to the normal duties, faculty and Students continuously involve themselves in research and development activities. AICTE, UGC have funded research projects. Skill and Personality Development Centre and PRERANA centres are established with funds received through AICTE.

Department of CSE has centers of excellence in Internet of Things, Artificial Intelligence/Machine Learning, Cyber Security, Association for Artificial Intelligence in HealthCare. Department is also having MoU's with MSME, Robotic Process Automation, Kernel Sphere Technologies, Telangana State Council of Science and Technology and Data Security Council of India.

Department has committed well qualified and professionally active staff.   Most of them are pursuing Ph.D. in the emerging areas like AI, ML, Cyber Security, Data Science, Data Mining and Block Chain.

Department is professionally active in conducting workshops and certifications with Microsoft, IBM, Oracle, SAP, Pega . Various activities are also conducted in collaboration with professional bodies like CSI, ISTE along with student branches of IEEE and CSI.

Department encourages the use of open source software and has vibrant technical clubs: CBIT Open Source (COSC) Club and CBIT Information Security Club (CISC). Through these clubs students have participated in various international and national Hackathons and bagged several prizes. Consecutively for the past three years CSE students have won first prize in Smart India Hackathon (SIH).

Students have participated in large numbers and won many worthy prizes in national and international coding competitions. They also presented papers in conferences and attended seminars, bootcamps and workshops.

CSE has maintained an excellent placement record by providing its students with ample opportunities to pursue their career goals. Leading companies that visited the campus for placements include Microsoft, JPMorgan, Accolite, NCR, Oracle, TCS, Infosys, Deloitte, D.E.Shaw, Sales Force, Service Now, Modak, etc., with CTC going well beyond 24 LPA. The number of students who are doing internship is gradually increasing year by year.

During 2017-18, 204 CSE students secured 287 job offers. In 2018-19, the offers increased to 291 for 214 students, further 311job offers for 224 students during 2019-20. The salary trend in CSE has improved over the years with an average salary being 7.1 LPA. The highest salary offered in Placement 2020 is 41.6LPA. Microsoft offered the highest CTC of 41.60 LPA. Six students have got their placement in Microsoft with the Super Dream Offer. From the batch of 211 students, 65 students secured multiple job offers out of which 23 students secured three offers.

ABOUT B.E. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING PROGRAMME

Every industry or human being is virtually impacted by Artificial Intelligence. It can be applied to every sector to enable new possibilities and efficiencies. AI is the main driver of emerging technologies like Big Data, robotic and IoT. AI technology is important because it enables human capabilities of understanding, reasoning, planning, communication and perception to be undertaken by software increasingly effective, efficient and at low cost. It can make the machines to do jobs that human does. Machine learning is an application of AI that enables the machines to learn and advance automatically from experience. The AI based applications can be found in various sectors. According to the Gartner prediction, the global AI software revenue is $62.5 billion in 2022.

CBIT offers BE(AI & ML) programme covering the topics of Data Science, Machine Learning, Artificial Intelligence and Robotics, Data Engineering and Data Science apart from Computer and other core fundamentals of Engineering programs. As per Government of India Vision document, plan to deploy AI in retail, transport, utilities, education and Public Health etc.,. Students shall look forward toa wide variety of careers after graduating from our BE programme in AI & ML.

Career Prospect :
- Big Data Engineer
- Machine Learning Engineer
- Data Engineer / Architect
- Business Intelligence Developer
- Data Scientist
- Research Scientist
- AI Data Analyst
- Product Manager
- AI Engineer
- …..

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of I Semester of
B.E.-Artificial Intelligence & Machine Learning
as per AICTE Model Curriculum 2022-23

SEMESTER – I

S. No	CourseCode	Title of the Course	Scheme of Instruction Hours per Week			Duration of SEE in Hours	Maximum Marks		Credits
			L	T	P/D		CIE	SEE	
THEORY									
1	20MTC01	Linear Algebra & Calculus (M-I)	3	1	0	3	40	60	3
2	20PY C01	Optics and Semiconductor Physics	3	0	0	3	40	60	3
3	20CSC01	Problem Solving and Programming	3	1	0	3	40	60	3
4	20EGC 01	English	2	0	0	3	40	60	2
PRACTICAL									
5	20MT C02	Linear Algebra & Calculus Lab	0	0	3	3	50	50	1
6	20EG C02	English lab	0	0	2	3	50	50	1
7	20PY C03	Optics and Semiconductor Physics Lab	0	0	4	3	50	50	2
8	20CS C02	Programming Lab-1	0	0	4	3	50	50	2
9	20MEC01	CAD/Drafting	0	1	3	3	50	50	2.5
10	20MB C02	Community Engagement	30 field + 2P/W			3	50	50	1.5
		TOTAL	11	1	15	-	460	540	21

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

21CSC001

PROBLEM SOLVING AND PROGRAMMING

Instruction	2L-1T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are to:

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

Course Outcomes: After completion of course, students would be able to:
1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data
6. Handle data using files

UNIT I:
Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II:
Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III:
Conditional Statement. Loops, Arrays and Strings, user-defined Data Types -if..else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV:
Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V:
File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

Text Books and References:
1. R.S. Salaria, Khanna , "Programming for Problem Solving", Book Publishing Co., Delhi.
2. Jeeva Jose, Khanna , "Taming Python by Programming", Book Publishing Co., Delhi.
3. Mark Lutz, "Learning Python", 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by No Starch Press.

5. Eric Matthes,, "Programming in Python", R.S. Salaria, Khanna Book Publishing Co., Delhi.
6. https://www.coursera.org/specializations/python-3-programming.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta , IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.

21 ENG 01

TECHNICAL ENGLISH
(Common to all branches)

Instruction	2 Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	2

Course Objectives: This course will introduce the students:
1. To the role and importance of communication while developing their basic communicationskills in English.
2. To basics of writing coherent paragraphs and formal emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formalreports following a proper structure.
5. To gaining adequate reading comprehension techniques.

Course Outcomes: After successful completion of the course the students will be able to:
1. Illustrate the nature, process and types of communication and communicate effectively withoutbarriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammarand appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by draftingformal reports.
5. Critique passages by applying effective reading techniques

UNIT-I Understanding Communication in English:
Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.
Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II Developing Writing Skills I:
Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.
Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III Developing Writing Skills II:
Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter;Letter of request and the response
Vocabulary and Grammar: Subject-verb agreement.
Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV Developing Writing Skills III:
Report writing – Importance, structure, elements of style of formal reports; Writing a formal report. Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms andantonyms.

UNIT-V Developing Reading Skills:
The reading process, purpose, different kinds of texts; Reading comprehension; Techniques ofcomprehension – skimming, scanning, drawing inferences and conclusions.
Vocabulary and Grammar: Words often confused; Use of standard abbreviations.

Text Books:
1. Language and Life: A Skills Approach, Board of Editors, Orient Black Swan, 2017.
2. Swan Michael, Practical English Usage.OUP. 1995.

Suggested Readings:
1. Wood F.T, Remedial English Grammar,Macmillan,2007
2. Zinsser William, On Writing Well, Harper Resource Book, 2001
3. Sanjay Kumar and PushpLata, Communication Skills. Oxford University Press, 2011.

21 ENG 02

TECHNICAL ENGLISH LAB
(Common to all branches)

Instruction	2 Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1

Course Objectives: This course will introduce the students:
1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To IELTS and TOEFL material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focusbeing on fluency rather than accuracy.
5. To team work, role behaviour while developing their ability to discuss in groups and making oralpresentations.

Course Outcomes: After successful completion of the course the students will be able to:
1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze IELTS and TOEFL listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Groupdiscussions.

Exercises
1. **Introduction to English Phonetics:** Introduction to auditory, acoustic and articulatory phonetics,organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English:** Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs. Thesyllable: types of syllables, consonant clusters.
3. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm &Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with IELTS and TOEFL material
6. **Public speaking** – Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions** - Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary** – weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on thehints given
10. **Poster presentation** – Theme, poster preparation, team work and presentation.

Suggested Reading
1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt. Ltd.,2011
4. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016

21CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	0L-0T-3P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	1.5

Course Objectives: The objectives of this course are to:

1. Master the fundamentals of writing Python scrips
2. Learn Python elements such as variables, flow controls structures, and functions
3. Discover how to work with lists and sequence data, and files

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

1. Understand various Python program development Environments
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

Laboratory/ Practical Experiments:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations
3. Demonstration of operators
4. Demonstration of selective control structures
5. Demonstration of looping control structures
6. Demonstration of Python Dictionaries.
7. Implementation of searching and sorting techniques.
8. Implementation of string manipulation operations
9. File handling and memory management operations

21MEC01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2.5

Course Objectives: The objectives of this course are
1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

Course Outcomes: At the end of the course, the Students are able to
1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

List of Exercises:
1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice versa.

Text Books:
1. N.D. Bhatt, "Elementary Engineering Drawing", Charotar Publishers, 2012.
2. K.Venugopal, "Engineering Drawing and Graphics + AutoCAD", New Age International Pvt. Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, "Engineering Drawing", 2/e, Mc Graw-Hill Education (India) Pvt. Ltd.

Suggested Reading:
1. Shaw M.B and Rana B.C., "Engineering Drawing", 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011.

21MBA02
COMMUNITY ENGAGEMENT

Instruction	3 Hours per week (30 hours field work & 2 hours per week)
SEE	Nil
CIE	50 Marks
Credits	1.5 Credits

Course Objectives: The main Objectives of this Course are to:
1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

Course Outcomes: After the completion of this Course, Student will be able to:
1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Module I Appreciation of Rural Society
Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature andResources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood
Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions
Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes
History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

Text Books:
1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi,2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies,2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:
1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instructions of II Semester of
B.E.-Artificial Intelligence & Machine Learning
as per AICTE Model Curriculum 2022-23

SEMESTER – II

S. No	CourseCode	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Durationof SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	20MT C03	Differential Equations & Transform Theory	3	-	-	3	40	60	3
2	20CYC01	Chemistry	3	-	-	3	40	60	3
3	20CS C05	Industry 4.0	3	-	-	3	40	60	3
4	21CSC03	Object Oriented Programming	3	-	-	3	40	60	3
PRACTICAL									
5	20MT C04	Differential Equations &Transform Theory Lab	0	0	3	3	50	50	1
6	20CYC02	Chemistry Lab	0	0	3	3	50	50	2
7	20CSC04	Object Oriented Programming Lab	0	0	2	3	50	50	1
8	20ME C02	Workshop / Manufacturing Practice	0	2	3	3	50	50	2.5
9	20ME C03	Engineering Exploration	0	0	2	-	50	-	1.5
	TOTAL		**12**	**-**	**13**	**-**	**410**	**440**	**20**

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

21CH M01

CHEMISTRY
(Common to all branches)

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

Course Objectives: The objectives of this course are
1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

Course Outcomes: At the end of the course student will be able to:
1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

UNIT-I Atomic and molecular structure and Chemical Kinetics:
Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2 , He^+ ,N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.
Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction- Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II Use of free energy in chemical equilibria
Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, – Reference electrodes (NHE, SCE)- electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.
Battery technology: Rechargeable batteries & Fuel cells.
Lithium batteries: Introduction, construction, working and applications of Li-MnO2 and Li-ion batteries. Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages.
Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III Stereochemistry and Organic reactions
Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity,

Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (SN1& SN2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides) Cyclization (Diels - Alder reaction)

UNIT–IV   Water Chemistry:

Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process),ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V Engineering Materials and Drugs:

Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.

Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).

Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

Text Books:
1.   P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2.   W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3.   R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition(2019).
4.   A Textbook of Polymer Science and Technology , Shashi Chawla, Dhanpat Rai & Co. (2014)
5.   T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6.   G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

Suggested Readings:
1.   B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2.   B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3.   T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12th edition (2017).
4.   P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford,8th edition (2006).

21CSC03

OBJECT ORIENTED PROGRAMMING

Instruction	3L-0T-0P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: The objectives of this course are to:
1. Explore the concepts object-oriented programming like classes, constructors, Polymorphism, Inheritance, and File handling.
2. Prepare student for solving real-world problems using OOPs concepts.

Course Outcomes: After completion of course, students would be able to:
1. Understand the concepts of Object-Oriented features.
2. Apply OOPs concepts and different libraries to solve programming problems.
3. Understand the advanced concepts of Python.
4. Develop programs to access databases and web data.
5. Understand APIs and third-party libraries to be used with Python.

UNIT I:
Introduction to Object Oriented Programming Paradigms - Programming paradigms, advantages of OOP, comparison of OOP with Procedural Paradigms; Classes and Objects: Prototyping, referencing the variables in functions, inline, static and friend functions. Memory allocation for classes and objects, arrays of objects, constructors.

UNIT II :
Polymorphism and Inheritance: Overriding methods, type conversions, base classes and derived classes, types of inheritance, various types of classes, invocation of constructors and destructors inheritance, aggregation, composition, classification hierarchies, metaclass/ abstract classes, unit testing and exceptions.

UNIT III:
Python Libraries -Basics of Open Source libraries for data pre-processing, modeling and visualization.

UNIT IV:
Python to access Web Data - Regular Expressions, extracting data, sockets, using the Developer Console to Explore HTTP, Retrieving Web Page, and Passing Web Pages.

UNIT V:
Using Databases with Python - Using Databases, Single Table CRUD, Designing and representing a data model, reconstructing data with JOIN, many-to-many relationships.

Text Books and References:
1. Allen Downey, Jeff Elkner, Chris Meyers, "How to Think Like a Computer Scientist: Learning with Python", SoHo Books, 2009.
2. R.S. Salaria , "Mastering Object-Oriented Programming", Khanna Book Publishing Co., Delhi
3. Jeeva Jose, "Introduction to Computing & Problem Solving with Python", Khanna Book Publishing, 2019.
4. https://www.coursera.org/specializations/python-3-programming#courses
5. Paul Barry , "Head First Python", O'Reilly, 2010

NPTEL/SWAYAM Course:

1. Python for Data Science, Prof. Raghunathan Rengasamy, IIT Madras
2. The Joy of Computing using Python Prof. Sudarshan, Prof. Yayati Guptaingar, IIT Ropar, IIIT Dharwad.

21CH M02

CHEMISTRY LAB
(Common to all branches)

Instruction	4 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	2

Course Objectives : The objectives of this course are
1. To impart fundamental knowledge in handling the equipment / glassware and chemicals inchemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improveunderstanding of theoretical concepts.
5. To interpret the theorical concepts in the preparation of new materials like drugs and polymers.

Course Outcomes : At the end of the course student will be able to:
1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function oftime.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

Chemistry Lab
1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide.(second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH3COOH present in the given mixture of acidsConductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using KMnO4 solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

Text Books:
1. J. Mendham and Thomas , "Vogel's text book of quantitative chemical analysis", Pearson educationPvt. Ltd. New Delhi , 6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati,; R. Chand & Co. : NewDelhi (2011).

Suggested Readings:
1. Dr.Subdharani , "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara , "A Textbook on experiment and calculation in engineering chemistry", S.Chand andCompany, 9th revised edition, 2015.

20ME C02

WORKSHOP / MANUFACTURING PRACTICE

Instruction	5P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

Course Objectives: The objectives of this course are
1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive &team work attitude to get things right the first time.
3. To provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. To advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

Course Outcomes: At the end of the course, the students are able to
1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in fitting, carpentry, tin smithy, house wiring, welding, casting and machining processes.
3. Make a given model by using workshop trades including fitting, carpentry, tinsmithy andHouse wiring.
4. Perform various operations in welding, machining and casting processes.
5. Conceptualize and produce simple device/mechanism of their choice.

List of Exercises
CYCLE 1
Exercises in Carpentry
1. To plane the given wooden piece to required size
2. To make a lap joint on the given wooden piece according to the given dimensions.
3. To make a dove tail-joint on the given wooden piece according to the given dimensions.

Exercises in Tin Smithy
1. To make a rectangular box from the given sheet metal with base and top open. Solder thecorners.
2. To make a scoop.
3. To make a pamphlet box.

Exercises in Fitting
1. To make a perfect rectangular MS flat and to do parallel cuts using Hacksaw
2. To make male and female fitting using MSflats-Assembly1
3. To make male and female fitting using MSflats-Assembly2

Exercises in House Wiring
1. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bellpush
2. Wiring of two light points connected in series and controlled by single pole switch. Verifythe above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
3. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.

CYCLE 2

Exercises in Casting
1. Study of Sand casting process and its applications.
2. Green sand moulding practice for a single piece pattern
3. Green sand moulding practice for a split pattern with a horizontal core

Exercises in Welding
1. Study of gas welding equipment and process. Identification of flames, making of Butt joint with gas welding.
2. Study of Arc welding process, making Butt joint with DCSP,DCRP
3. Study of Arc welding process, making Lap joint with A.C

Exercises in Machine shop
1. Study of Machine Tools like Lathe, Drilling, Milling and Shaper.
2. Facing, Plain turning and Step turning operations on Lathe machine.
3. Knurling and Taper turning on Lathe machine

Open ended Exercise:
1. Student should produce a component /mechanism by applying the knowledge of any one tradeor combination of trades.

Text Books:
1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I, 2008 and Vol. II, 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata Mc Graw Hill House, 2017.

Suggested Reading:
1. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I", Pearson Education,2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India,1998.

20CSC04

OBJECT-ORIENTED PROGRAMMING LAB

Instruction	0L-0T-2P
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	1

Course Objectives: The objectives of this course are to:
1. Master the concepts of Object Oriented Programming.
2. Explore the OOPs features of Python and build applications.

Course Outcomes: After completion of course, students would be able to:
1. Demonstrate the features of Object-Oriented Programming.
2. Understand APIs and third-party libraries to be used with Python.
3. Use Python libraries to solve real-world problems.
4. Write scripts to solve data science/machine leaning problems using NumPy and Pandas.
5. Develop applications by accessing web data and databases.

Laboratory / Practical:
1. Write a NumPy program to compute the cross product of two given vectors.
2. Write NumPy program to calculate the QR decomposition of a given matrix.
3. Write a Pandas program to convert a Panda Module Series to Python list and its type.
4. Write a Pandas program to convert a NumPy array to a Pandas series.
5. Create a Python project to get the citation from Google scholar using title and year of publication and volume and pages of journal.
6. Create a Python project to get total COVI-19 cases, total deaths due to Covid-19, total Covid-19 patients recovered in the world.

Text Book:
1. Reema Thareja, "Python Programming", Oxford Press, 2017.

Online Resources:
1. https://vknight.org/cfm/labsheets/04-object-oriented-programming/
2. http://learning-python.com/class/Workbook/x-exercises.htm
3. https://inst.eecs.berkeley.edu/~cs61a/fa14/lab/lab06/#inheritance
4. https://anandology.com/python-practice-book/object_oriented_programming.html
5. http://stanfordpython.com/
6. https://docs.python.org/3/

21MECXX

ROBOTICS AND DRONES

Instruction   0L-2T-3P
Duration of SEE   3 Hours
SEE   50 Marks
CIE   50 Marks
Credits   3.5

Course Objectives: The objectives of this course are to:

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamatic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

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

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and OpenCV.

Lab Experiments:

1. Assembling of robot mechanical components, mounting of motors, senors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs:i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. OpenCV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. OpenCV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects:i)Making a line follower robot using a Camera; ii) Writing code for complex

Few Readings:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/