Final

DIPLOMA CURRICULUM OF CHEMICAL ENGINEERING (THIRD YEAR) (6th Semester)

(To be implemented from 2026-27)

Prepared by;

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Vetted by:
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SEMESTER – VI

SL. No	Category of Course	Code No	Course Title	Teaching Scheme				Evaluation Scheme				Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam	Progressive Assessment		
1	**Programme core**	CHEPC302 TH:1	Chemical Technology		3	0	0	70	30	-	-	100	3
2		CHEPC304 PR:1	Chemical Technology Lab		0	0	4	-	-	15	35	50	2
3	**Humanities and Social Science**	HS302 TH:2	Entrepreneurship and start ups		4	0	0	70	30	-	-	100	4
4	**Open Elective**	OE302 (Any One) TH:3	a. Project Management b. Disaster Management c. Artificial Intelligence d. Soft Computing Techniques		3	0	0	70	30	-	-	100	3
5		OE304 (Any One) TH:4	a. Engg. Economics & Accountancy b. IoT c. Sustainable Development d. Robotics		3	0	0	70	30	-	-	100	3
6	**Mandatory**	AU302 TH:5	INDIAN CONSTITUTION		2	0	0	0	0	-	-	0	0
7	**Major Project**	PR302 PR:2	MAJOR PROJECT (PHASE – II)		0	0	6	-	-	100	100	200	3
8	**Seminar**	SE302	SEMINAR		0	0	2	-	-	30	70	100	1
TOTAL					**15**	**0**	**12**	**280**	**120**	**145**	**205**	**750**	**19**

CONTENT DETAILS OF SEMESTER - VI

TH:1- CHEMICAL TECHNOLOGY

L	T	P		
3	0	0		**Course Code: CHEPC302**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PC

RATIONALE:

The chemical industry comprises of companies that mainly emphasise in production of industrial chemicals and products. A chemical engineer will primarily work in plants which manufacture various chemical products. Therefore, knowledge of the chemical processes, information about raw material requirement, chemistry of finished product are essential for a student to deal with the manufacturing process and process development in his professional career.

LEARNING OUTCOMES:

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

- Identify and determine the raw materials and the amount required.
- Describe manufacturing process of various chemical industries.
- State use of various equipment/instruments used in process industry.
- Explain chemistry involved and outlines of manufacturing of some organic and inorganic chemicals and polymers which are of highly significant in daily life.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**INDUSTRIAL GASES:** Raw materials, Process description, Reactions and Diagram in the production of Producer Gas, Water Gas, Coke Oven Gas, Synthesis Gas and Ammonia	**4**
II	**ACID INDUSTRIES:** Raw materials, Process description, Reactions & Diagram in the manufacture of Sulphuric Acid by DCDA process, and Nitric acid by Ammonia Oxidation or Ostwald's process	**4**
III	**CHLORO–ALKALI INDUSTRY:** Raw materials, Process description, Reactions and Diagram in the manufacture of Soda Ash by Solvay process and Caustic Soda by Electrolysis of brine; Classification of electrolytic cells with advantages & disadvantages	**6**
IV	**SUGAR INDUSTRY,PULP AND PAPER INDUSTRY:** Raw materials, Process description, Reactions and Diagram in the manufacture of Sugar and its byproduct utilization; Types of paper products; Additives used in paper production; Manufacturing process of Paper by Wet process;Manufacturing process of Pulp by Kraft process	**6**
V	**METALLURGICAL INDUSTRIES:** Manufacturing of cast iron; Different methods of steel manufacturing; Manufacturing of alumina from bauxite by Bayer's process; Extraction of aluminum by Hall- Heroult process	**5**

VI	**FERTILIZERS, PESTICIDES:** Classification of fertilizers; Manufacturing process of Urea; Manufacturing process of Di-ammonium Phosphate; Manufacturing process of Ammonium Nitrate; Manufacturing process of SSP and TSP; classification of pesticides, Raw materials, Reaction Equations of DDT manufacturing along with sketch	**10**
VIII	**OILS , SOAPS:** Classification of oil; Extraction of vegetable oil from seed along with detailed description; Purpose of hydrogenation of oil; Concept of iodine value, acid value, rancidity, winterizing; Chemical reactions involved in Hydrogenation of oil; Difference between soap and detergent; Manufacturing of soap with description and diagram, Chemical reaction involved; Saponification value, oil value of soap	**10**
Total		**45**

REFERENCES:

1.	C Dryden, Chemical Technology, Tata McGraw Hill
2.	N Shreeve, Chemical Process Industries, Tata McGraw Hill

PR:1- CHEMICAL TECHNOLOGY LAB

L	T	P		
0	0	4		**Course Code: CHEPC304**
Total Contact Hours				**Practical Assessment**
Practical		: 60Hrs	**Total Marks: 50**	End Term Exam 15
				Progressive Assessment : 35
Pre Requisite		**: Nil**		
Credit		**2**		Category of Course : PC

RATIONALE:

The Chemical Technology Laboratory is a cornerstone of the Chemical Engineering curriculum, designed to provide students with practical experience in applying theoretical concepts to real-world chemical processes. This hands-on approach is essential for developing the skills and knowledge necessary to address complex challenges in the chemical industry.

LEARNING OUTCOMES:

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

- Enable students to apply principles learned in lectures to practical scenarios.
- Provide insights into designing and optimizing chemical processes.
- Prepare students for real-world challenges in the chemical industry.
- Explain the basic principles of Chemical Technology

LIST OF EXPERIMENTS:

Sl No.	Name of Experiments
1	Prepare Soap from vegetable oil
2	Estimate free alkali present in soap
3	Determine the acid value of an oil
4	Determine the saponification value of an oil
5	Determine the % of available chlorine in a given sample of bleaching power
6	Determine the % of nitrogen in a fertilizer sample

REFERENCES:

1.	S K Basin & Sudharani, Laboratory manual on Engineering Chemistry, Dhanpat Rai

TH:2- ENTREPRENEURSHIP AND START UPS

L	T	P		
4	0	0		**Course Code: HS302**
Total Contact Hours				**Theory Assessment**
Theory		: 60Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**4**		Category of Course : HS

RATIONALE:

Entrepreneurship and Startups are introduced in curriculum to develop the entrepreneurship traits among the students before they enter into the professional life exposing themselves to and interacting with entrepreneurship and startup eco-system, student will develop and entrepreneurial mind set. It is important because they can help the students to develop the skills and knowledge needed to start and grow businesses and understand how to turn their ideas into successful ventures.

LEARNING OUTCOMES:

After the completion of the course, the student shall be able to

- Develop Entrepreneurial spirit and resourcefulness.
- Familiar with various uses of human resources for earning dignified means of living.
- Explain the concept and process of entrepreneurship - its contribution and role in the growth and development of individuals and the nation.
- Define entrepreneurial quality, competency, and motivation.
- Learn the process and skills of creation and management of entrepreneurial ventures.

DETAILED COURSE CONTENTS

Unit	Topic/Sub topic	Hours
I	Introduction to Entrepreneurship and Start- Ups: Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation; Types of Business Structures, Similarities/differences between entrepreneurs and managers.	12
II	Business Ideas and their implementation: Discovering ideas and visualizing the business, Activity map, Business Plan.	08
III	Idea to Start-up: Market Analysis- Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis.	10
IV	Management: Company's Organization Structure, Recruitment and management of talent, financial organization and management.	12
V	Financing and Protection of Ideas: Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses	10
VI	Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy.	8

REFERENCES:

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank and Bob Dorf K & S Ranch, ISBN – 978-0984999392.

2. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Penguin UK, ISBN – 978-0670921607.

3. Demand: Creating What People Love Before They Know They Want It, Adrian J. Slywotzky with Karl Weber, Headline Book Publishing, ISBN – 978-0755388974.

4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business, Clayton M. Christensen, Harvard business ISBN: 978-142219602.

Websites:

- https://www.fundable.com/learn/resources/guides/startup
- https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/
- https://www.finder.com/small-business-finance-tips
- https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/

TH:3(a)- PROJECT MANAGEMENT

L	T	P		
3	0	0		**Course Code: OE302**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE

The aim of this course is to develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how to achieve the goals. The students will develop an understanding of key project management skills and strategies.

LEARNING OUTCOMES

On successful completion of the course, students will be able to:

- List out the importance of projects and its phases.
- Define projects from marketing, operational and financial perspectives.
- Analyze projects based on discount and non-discount methods.
- Construct network diagrams for planning and execution of a given project.
- Apply crashing procedures for time and cost optimization.

DETAILED COURSE CONTENT

UNIT	TOPIC/SUB-TOPIC	HRS.
I.	**CONCEPT OF A PROJECT**: Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time) project priority matrix-work break down structure.	**9**
II.	**CAPITAL BUDGETING PROCESS:** Planning- Analysis-Selection-Financing-Implementation-Review. Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process-Technical analysis	**9**
III.	**FINANCIAL ESTIMATES AND PROJECTIONS:** Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability projected cash flow statement and balance sheet. Break-even analysis.	**9**

IV.	**BASIC TECHNIQUES IN CAPITAL BUDGETING**: Non discounting and discounting methods- payback period- Accounting rate of return- net present value-Benefit cost ratio-internal rate of return. Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects**.**	**9**
V.	**PROJECT ADMINISTRATION**: Progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off. Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management soft wares.	**9**

REFERENCES:

- Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
- Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson - McGraw Hill
- Project management - David I Cleland - Mcgraw Hill International Edition, 1999
- Project Management – Gopala krishnan – Mcmillan India Ltd.
- Project Management-Harry-Maylor-Peason Publication

TH:3(b)- DISASTER MANAGEMENT

L	T	P		
3	0	0		**Course Code: OE302**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE

Disasters can be caused by both natural and man-made factors. They cannot be anticipated, and once they do, they must be handled with maturity, subtlety, and responsibility. Numerous immediate decisions must be made, and relief efforts must be planned and managed. Thus this course provides to the civil engineers, a proper knowledge regarding the disasters along with how they affect the environment and living things.

LEARNING OUTCOMES

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

- Use of basic information on various types of disasters to control the disaster
- Take the precautions during various disasters
- Decide first action to be taken under various disasters
- Communicate with others in India which are dealing with disasters
- Select IT tools to help in disaster management

DETAILED COURSE CONTENT

UNIT NO.	CONTENT	TIME ALLOTTED (HOURS)
UNIT-I	**Understanding Disaster** • Understanding the Concepts and definitions of Disaster, Hazard, • Vulnerability, Risk, Capacity • Disaster and Development, and disaster management	**05**

UNIT-II	**Types, Trends, Causes, Consequences and Control of Disasters** • Geological Disasters (earthquakes, landslides, tsunami, • mining); Hydro-Meteorological Disasters (floods, • cyclones, lightning, thunder-storms, hail storms, • Avalanches, droughts, cold and heat waves) Biological (3rd yr)/First Draft/May, 2023. Disasters (epidemics, pest attacks, forest fire); • Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.	**10**
UNIT-III	**Disaster Management Cycle and Framework**	**10**
	• Disaster Management Cycle – Paradigm Shift in Disaster Management. • Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. • During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – • Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Frame-work of Action	
UNIT-VI	**Disaster Management in India** • Disaster Profile of India – Mega Disasters of India and Lessons Learnt. • Disaster Management Act 2005 – Institutional and Financial Mechanism, • National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non- Government and Inter Governmental Agencies	**10**
UNIT-V	**Applications of Science and Technology for Disaster Management** • Geo-informatics in Disaster Management (RS, GIS, GPS and RS). • Disaster Communication System (Early Warning and Its Dissemination). • Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters • Institutions for Disaster Management in India	**10**
	TOTAL	**45**

REFERENCES:

- Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
- Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi
- Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi
- 4. Alexander, David, Natural Disasters, Kluwer Academic London
- Ghosh, G. K., Disaster Management, A P H Publishing Corporation
- Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

TH:3(c)- ARTIFICIAL INTELLIGENCE

L	T	P		
3	0	0		**Course Code: OE302**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE:

Artificial Intelligence (AI) empowers machines to mimic human intelligence, enabling tasks such as decision-making, problem-solving, and learning. It drives innovation across industries, from healthcare to robotics, by automating complex processes and uncovering insights from data. Learning AI equips students with cutting-edge skills to build intelligent systems and shape the future of technology.

LEARNING OUTCOMES:

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

- Explain key concepts in Artificial Intelligence such as intelligent agents, search algorithms (uninformed, informed, local), and neural network architectures.
- Explain the principles of decision-making models, including Markov Decision Processes and reinforcement learning, and their applications in AI.
- Implement search algorithms, logic-based agents, and neural network architectures (feedforward, CNN, RNN) to solve AI-related problems.
- Analyze the performance of different neural network architectures and optimization techniques (e.g., gradient descent, Adam) to improve model accuracy and efficiency.
- Develop intelligent agents and neural network models for real-world applications, applying advanced learning techniques and optimization methods.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hour)
I	**Fundamentals of Artificial Intelligence:** Introduction: History and foundations of AI Intelligent Agents, Uninformed Search; informed Search; Local Search; Adversarial Search, Constraint Satisfaction Problems	6
II	**AI:** Logic, Planning, and Knowledge Representation, Logical Agents, First Order Logic and its Inference, Classical Planning, Knowledge Representation	6
III	**Bayesian Network:** Introduction to Probability, Conditional Probability, Conditional Independence, Bayesian Network, Representation Approximate Inference in Bayesian Networks, Learning in Bayesian Network.	6
IV	**Decision Making:** Decision Theory, Markov Decision Processes, Reinforcement Learning	6
V	**Neural Networks:** Neural Networks: Biological neurons vs. artificial neurons; History and development of neural networks, Neurons, weights, biases, Activation functions (Sigmoid, ReLU, Tanh, Softmax).	7
VI	**Neural Network Architectures:** Feedforward Neural Networks (Single-layer and multilayer architectures), Convolutional Neural Networks (CNNs, Filters, pooling, and feature maps), Recurrent Neural Networks (RNNs, Long Short-Term Memory (LSTM)), Learning and Training - Perceptron and its limitations; Multilayer perceptron (MLP) and Backpropagation; Overfitting and regularization	7
VII	**Optimization Techniques:** Gradient Descent and its Variants (Stochastic Gradient Descent (SGD), Momentum-based optimization, Adam optimizer), Learning Rate and Convergence - Impact of learning rate on training.	7

REFERENCES:

1.	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson/Prentice Hall, New Jersey, 2003.
2.	M.C. Trivedi, A Classical Approach to Artificial Intelligence, 1st Edition, Khanna Publishing House, New Delhi, 2018.
3.	V.K. Jain, Machine Learning, 1st Edition, Khanna Publishing House, New Delhi, 2018.
4.	Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, MIT Press, Cambridge, 2014.
5.	Vinod Chandra S.S. and Anand Hareendran S., Artificial Intelligence and Machine Learning, PHI Learning, New Delhi, 2014.

TH:3(d)- SOFT COMPUTING TECHNIQUES

L	T	P		
3	0	0		**Course Code: OE302**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE:

The Soft Computing Techniques course is designed to equip with the knowledge and skills required to solve complex real-world problems using intelligent, flexible, and approximate reasoning methods. In contrast to traditional "hard computing" approaches that demand exact solutions, soft computing embraces uncertainty, imprecision, and partial truth-making it ideal for solving practical problems in engineering, data science, and decision-making.

LEARNING OUTCOMES:

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

- Explain the Core Concepts of soft computing, including its need, scope, and its difference from traditional hard computing.
- Design Basic Neural Networks for classification, prediction, and pattern recognition tasks.
- Design Fuzzy Inference Systems using fuzzy sets, membership functions, and fuzzy rules.
- Apply Defuzzification Methods to convert fuzzy outputs into actionable results.
- Apply Genetic Operators like selection, crossover, and mutation to solve optimization and search problems.
- Apply Hybrid Models in fields like control systems, image processing, and decision-making.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Introduction to Soft Computing** - Overview of Soft Computing - Definition and importance of soft computing, Comparison between hard computing and soft computing, Applications of soft computing in various engineering fields, Components of Soft Computing - Introduction to Artificial Neural Networks (ANNs), Basics of Fuzzy Logic Systems (FLS), Overview of Genetic Algorithms (GAs).	8
II	**Artificial Neural Networks (ANNs)** - Fundamentals of ANNs, Biological inspiration and neural models, Types of activation functions, Architecture of neural networks: single-layer and multi-layer perceptrons, Learning Processes in ANNs - Supervised, unsupervised, and reinforcement learning, Backpropagation algorithm and its applications, Training, validation, and testing of neural networks, Applications of ANNs - Pattern recognition and classification, Function approximation and prediction, Case studies in engineering applications.	10
III	**Fuzzy Logic Systems (FLS)** - Introduction to Fuzzy Logic, Classical sets vs. fuzzy sets, Membership functions and their types, Fuzzy set operations, Fuzzy Rule-Based Systems - Linguistic variables and hedges, Formation of fuzzy if-then rules, Inference mechanisms and defuzzification techniques, Applications of Fuzzy Logic, Fuzzy control systems, Decision-making in uncertain environments, Engineering case studies utilizing fuzzy logic.	10
IV	**Genetic Algorithms (GAs)** - Basics of Genetic Algorithms - Evolutionary principles and natural selection, Chromosome representation and initialization, Fitness functions and selection mechanisms, Genetic Operators - Crossover techniques and their significance, Mutation operations and rates, Elitism and generational replacement strategies, Applications of Genetic Algorithms**,** Optimization problems in engineering, Scheduling and routing problems, Real-world case studies employing GAs.	10
V	**Hybrid Systems and Applications** - Integration of Soft Computing Techniques**,** Concept of hybrid systems combining ANNs, FLS, and Gas, Neuro-fuzzy systems: architecture and learning, Genetic-fuzzy systems and their applications, Practical Implementations - Designing hybrid models for complex problem-solving, Simulation and analysis of hybrid systems, Case studies demonstrating the effectiveness of hybrid approaches.	7

REFERENCES:

1.	Soft Computing: Fundamentals and Applications by D. K. Pratihar
2.	Soft Computing and Its Applications by Rafik Aziz Aliev and Rashad Rafik Aliev
3.	Soft Computing: Integrating Evolutionary, Neural, and Fuzzy Systems by Tettamanzi Andrea G. B. and Tomassini Marco

4.	Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence by Jyh-Shing Roger Jang et al.
5.	Neural Network, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications by S. Rajasekaran and G. A. Vijayalakshmi Pai

TH:4(a)- ENGINEERING ECONOMICS & ACCOUNTANCY

L	T	P		
3	0	0		**Course Code: OE303**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam 70
				Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : OE

RATIONALE:

The rationale behind studying "Engineering Economics and Accountancy" lies in equipping engineers with the necessary financial literacy to make informed decisions regarding project feasibility, cost analysis, and resource allocation by combining economic principles with accounting practices, ultimately allowing them to choose the most economically viable engineering solutions within a project's budget constraints.

LEARNING OUTCOMES:

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

- Describe the macro-economic environment of the business and its impact on enterprise
- Explain cost elements of the product and its effect on decision making
- Prepare accounting records and summarize and interpret the accounting data for managerial decisions
- Describe accounting systems and analyze financial statements using ratio analysis
- Express the concepts of financial management and investment

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Introduction:** Managerial Economics; Relationship with other disciplines; Firms: Types, objectives and goals; Managerial decisions; Decision analysis.	**8**
II	**Demand & Supply Analysis:** Demand; Types of demand; Determinants of demand; Demand function; Demand elasticity; Demand forecasting; Supply; Determinants of supply; Supply function; Supply elasticity	**9**

III	**Production and Cost Analysis:** Production function; Returns to scale; Production optimization; Least cost input; Isoquants; Managerial uses of production function; Cost Concepts; Cost function; Types of Cost; Determinants of cost; Short run and Long run cost curves; Cost Output Decision; Estimation of Cost.	**10**
IV	Determinants of Price; Pricing under different objectives and different market structures; Price discrimination; Pricing methods in practice; Role of Government in pricing control.	**7**
V	**Financial Accounting (Elementary Treatment):** Balance sheet and related concepts; Prof- it & Loss Statement and related concepts; Financial Ratio Analysis; Cash flow analysis; Funds flow analysis; Comparative financial statements; Analysis & Interpretation of financial statements; Investments; Risks and return evaluation of investment decision; Average rate of return; Payback Period; Net Present Value; Internal rate of return,	**11**
Total		**45**

REFERENCES:

1.	Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House, New Delhi, 2018
2.	McGuigan, Moyer and Harris, 'Managerial Economics; Applications, Strategy and Tactics', Thomson South Western, 10th Edition, 2005.
3.	Prasanna Chandra. 'Fundamentals of Financial Management', Tata McGraw Hill Publishing Ltd., 4th edition, 2005.
4.	Samuelson. Paul A and Nordhaus W.D., 'Economics', Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.
5.	Paresh Shah, 'Basic Financial Accounting for Management', Oxford University Press, New Del- hi, 2007. 3. Salvatore Dominick, 'Managerial Economics in a global economy'. Thomson South Western, 4th Edition, 2001.

TH:4(b)- INTERNET OF THINGS

L	T	P		
3	0	0		**Course Code: OE303**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE:

The Internet of Things (IoT) is revolutionizing the way devices communicate, interact, and function, creating a connected world that bridges physical and digital spaces. With industries embracing smart solutions in areas like healthcare, agriculture, manufacturing, transportation, and home automation, there is a growing demand for skilled professionals who can design, implement, and manage IoT systems.

LEARNING OUTCOMES:

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

- Explain Core IoT Concepts, including architecture, components, and communication models.
- Identify IoT Ecosystem Elements, such as sensors, actuators, microcontrollers, communication protocols, and cloud platforms.
- Integrate identified Hardware Components like Arduino, Raspberry Pi, sensors, and actuators for IoT projects.
- Analyze Sensor Data from IoT devices.
- Identify Common Security Threats in IoT ecosystems, including data breaches, device hijacking, and network vulnerabilities.

DETAILED COURSE CONTENT:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	**Introduction to Internet of Things (IoT) -** Overview of IoT - Definition and significance of IoT, Historical evolution and future prospects, Applications across various industries, IoT Architecture and Components, Basic architecture - sensors, actuators, connectivity, and data processing, Hardware components: microcontrollers (e.g., Arduino, Raspberry Pi), Software components: operating systems and middleware.	8
II	**Sensors, Actuators, and Data Acquisition:** Sensors and Actuators, Types of sensors: temperature, humidity, motion, etc., Actuators: motors, relays, and control mechanisms, Interfacing sensors and actuators with microcontrollers, Data Acquisition and Processing - Analog and digital data	10

	acquisition methods, Signal conditioning and filtering techniques, Introduction to data processing and storage.	
III	**Communication Protocols and Networking -** IoT Communication Protocols, Overview of protocols: MQTT, CoAP, HTTP, etc., Wireless communication: Wi- Fi, Bluetooth, Zigbee, LoRaWAN., Wired communication: Ethernet, Serial communication, Networking Fundamentals - IP addressing and subnetting, Network topologies and architectures, Introduction to IPv6 and its relevance to IoT.	10
IV	**IoT Platforms and Cloud Integration -** IoT Platforms, Overview of popular IoT platforms (e.g., AWS IoT, Google Cloud IoT), Data analytics and visualization tools, Edge computing concepts, Cloud Computing for IoT, Introduction to cloud services: IaaS, PaaS, SaaS, Integration of IoT devices with cloud platforms, Data storage, processing, and management in the cloud.	10
V	**IoT Security and Privacy -** Security Challenges in IoT, Common vulnerabilities and threats, Authentication and authorization mechanisms, Data encryption and secure communication, Privacy Considerations - Data privacy laws and regulations, User consent and data ownership, Best practices for ensuring privacy in IoT applications.	7

REFERENCES:

1.	Internet of Things by Jeeva Jose
2.	Internet of Things by Raj Kamal
3.	Internet of Things (IoT) by Dr. Kamlesh Lakhwani, Dr. Hemant Kumar Gainey, Joseph Kofi Wireko, and Kamal Kant Hiran
4.	Internet of Things: From research and innovation to market deployment by Dr. Ovidiu Vermesan and Dr. Peter Friess
5.	The Internet of Things in the Cloud: A Middleware Perspective by Honbo Zhou
6.	Internet of Things: Architectures, Protocols and Standards by Simone Cirani, Gianluigi Ferrari, Marco Picone, and Luca Veltri
7.	Internet of Things (IoT): Concepts and Applications edited by Dr. Jamil Y. Khan and Dr. Mehmet R. Yuce

TH:4(c)- SUSTAINABLE DEVELOPMENT

L	T	P		Course Code: OE303	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam	: 70
Tutorial		: 0		Progressive Assessment	: 30
Pre Requisite		**: Nil**			
Credit		**: 3**		Category of Course : OE	

RATIONALE:

The aim of this course is to develop an action mindset for sustainable development by imparting knowledge on environmental, social and economic dimensions of sustainability and related principles.

LEARNING OUTCOMES:

After Completion of the course, student will be able to

- Explain current challenges to sustainability, including modern world social, environmental, and economic structures and crises.
- Identify the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals
- Explain understanding of the social, economic and ecological linkage of Human well-being, production and consumption
- Discuss sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.
- Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

DETAILED COURSE CONTENT:

UNIT NO.	CONTENT	TIME ALLOTTED (HRS.)
I	**SUSTAINABILITY AND DEVELOPMENT CHALLEGES** Definition of sustainability – environmental, economical and social dimensions of sustainability – sustainable development models – strong and weak sustainability – defining development- millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century – global, regional and local environmental issues – social insecurity – resource degradation –climate	**9**

	change – desertification.	
II	**PRINCIPLES AND FRAME WORK** History and emergence of the concept of sustainable development – our common future – Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step- peoples earth charter – business charter for sustainable development –UN Global Compact – Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas.	**9**
III	**SUSTAINABLE DEVELOPMENT AND WELLBEING** The Unjust World and inequities – Quality of Life – Poverty, Population and Pollution – Combating Poverty – – Demographic dynamics of sustainability – Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.	**9**
IV	**SUSTAINABLE SOCIO-ECONOMIC SYSTEMS** Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries – Food security and nutrition and sustainable agriculture- Water and sanitation – Biodiversity conservation and Ecosystem integrity –Ecotourism – Sustainable Cities – Sustainable Habitats- Green Buildings – Sustainable Transportation — Sustainable Mining – Sustainable Energy– Climate Change –Mitigation and Adaptation – Safeguarding Marine Resources – Financial Resources and Mechanisms	**9**
V	**ASSESSING PROGRESS AND WAY FORWARD** Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context –Approaches to measuring and analysing sustainability– limitations of GDP Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development – Hurdles to Sustainability – Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals	**9**
		Total : 45

REFERENCE:

- Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012
- A guide to SDG interactions: from science to implementation, International Council for

Science, Paris,2017
- Karel Mulder, Sustainable Development for Engineers – A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.
- The New Global Frontier – Urbanization, Poverty and Environment in the 21st Century – George Martine, Gordon McGranahan,Mark Montgomery and Rogelio Fernández-Castilla, IIED and UNFPA, Earthscan, UK, 2008
- Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006
- Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.

TH:4(d)- ROBOTICS

L	T	P		
3	0	0		**Course Code: OE303**
Total Contact Hours				**Theory Assessment**
Theory		: 45 Hrs.	**Total Marks: 100**	End Term Exam : 70
Tutorial		: 0		Progressive Assessment : 30
Pre Requisite		**: Nil**		
Credit		**: 3**		Category of Course : OE

RATIONALE:

Robotics boosts skills that are the foundation of success, such as critical-thinking and problem-solving skills. When working on a robot, students are encouraged to use logic, engineering intuition, and critical thinking. Students can come up with problems in their everyday life that they think robots can fix. Allowing students to develop theories that can be tested in robotics projects will strengthen their ability to form hypotheses.

LEARNING OUTCOMES:

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

- Explain basic concepts, parts of robots and types of robots.
- Describe drive systems for robot, sensors and programming of robots.
- Select the robots according to its usage.
- Apply robots with justification and implementation of project.
- Design automation applications of robots in various industries.

DETAILED COURSE CONTENT

Unit	Topic/Sub Topic	Hours
I	**Fundamentals of Robotics:** Introduction; Definition; Robot anatomy (parts) and its working; Robot Components: Manipulator, End effectors; Construction of links, Types of joints; Classification of robots; Cartesian, Cylindrical, Spherical, SCARA, Vertical articulated; Structural Characteristics of robots; Mechanical rigidity; Effects of structure on control work envelope and work Volume; Robot work Volumes, comparison; Advantages and disadvantages of robots.	**9**
II	**Robotic Drive System and Controller:** Actuators; Hydraulic, Pneumatic and Electrical drives; Linear actuator; Rotary drives; AC servo motor; DC servo motors and Stepper motors; Conversion between linear and rotary motion; Feedback devices; Potentiometers; Optical encoders; DC tachometers; Robot controller; Level of Controller; Open loop and Closed loop controller; Microprocessor based control system; Robot path control: Point to point, Continuous path control and Sensor based path control; Controller programming.	**9**
III	**Sensors:** Requirements of a sensor; Principles and Applications of the following types of sensors: Position sensors (Encoders, Resolvers, Piezo Electric); Range	**9**

	sensors (Triangulation Principle, Structured lighting approach); Proximity sensing; Force and torque sensing. Introduction to Machine Vision: Robot vision system (scanning and digitizing image data); Image processing and analysis; Cameras (Acquisition of images); Videocon camera (Working principle & construction); Applications of Robot vision system: Inspection, Identification, Navigation & serving	
IV	**Robot kinematics and Robot Programming:** Forward Kinematics; Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Freedom (In 2 Dimensional); Deviations and Problems. Robot programming Languages; VAL Programming; Motion Commands; Sensor Commands; End effecter commands; and Simple programs	**9**
V	**Automation:** Basic elements of automated system, advanced automation functions, levels of automation. Industrial Applications: Application of robots in machining; welding; assembly and material handling	**9**

REFERENCES:

- Introduction to Robotics: Analysis, Systems, Applications – Saeed B. Niku
- Industrial Robotics: Technology, Programming and Applications – M.P. Groover
- Robotics Control, Sensing, Vision and Intelligence – Fu.K.S. Gonzalz.R.C and Lee C.S.G,
- Robotics for Engineers – Yoram Koren
- A Text book on Industrial Robotics – Ganesh S. Hedge
- Robotics Technology and Flexible Automation – S.R. Deb & Sankha Deb
- Elements of Robotics Process Automation, Mukherje

TH:5- INDIAN CONSTITUTION

L	T	P		
2	0	0		**Course Code: AU302**
Total Contact Hours				**Theory Assessment**
Theory		: 30Hrs		End Term Exam 0
			Total Marks: 0	Progressive Assessment : 0
Pre Requisite		**: Nil**		
Credit		**0**		Category of Course : AU

RATIONALE

The basic aim of this subject is to educate the students about constitution of India. As future citizen of India, student will acquire knowledge about individual rights, fostering democracy, the advancement of social welfare through directive principles, maintenance of balanced federal structures, and the upholding the rules and laws for a diverse nation

LEARNING OUTCOMES:

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

- Acquire the fundamental principle features and structures of Indian Constitution.
- Apply constitutional provision to analyse and evaluate real world scenario,
- Demonstrate the impact of constitutional rights and duties on individuals and societies
- Evaluate the effectiveness of directive principles of state policy in promoting the justice, economies welfare and inclusive growth
- Synthesize the core values such as secularism, equality and justice and apply them to contemporary issues.

COURSE CONTENT DETAILS

UNIT NO & TITLE	CONTENT	LECTURE HOURS
UNIT –I	**The Constitution - Introduction** • The History of the Making of the Indian Constitution • Preamble and the Basic Structure, and its interpretation • Fundamental Rights and Duties and their interpretation • State Policy Principles	**6**
UNIT –II	**Union Government** • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha	**6**

UNIT –III	**State Government** • Governor – Role and Power • Chief Minister and Council of Ministers • State Secretariat	**6**
UNIT –IV	**Local Administration** • District Administration • Municipal Corporation • Zila Panchayat	**6**
UNIT –V	**Election Commission** • Role and Functioning • Chief Election Commissioner • State Election Commission	**6**
Total		**30**

REFERENCES:

1.	Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2.	The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3.	Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition

Suggested Software/Learning Websites:
a. https://www.constitution.org/cons/india/const.html
b. http://www.legislative.gov.in/constitution-of-india
c. https://www.sci.gov.in/constitution
d. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/

PR:2- MAJOR PROJECT

L	T	P		
0	0	6		**Course Code: PR302**
Total Contact Hours				**Practical Assessment**
Practical		: 90Hrs	**Total Marks: 200**	End Term Exam 100
				Progressive Assessment : 100
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PR

RATIONALE:

A Major project is generally requires a larger amount of effort and more independent work than that involved in a normal assignment. It requires students to undertake their own fact-finding and analysis. The students will select the topic, perform and design work. Major project is as preparation for the students to take on more responsibilities and bigger project in the future. It is a learning experience, which aims to provide students with the opportunity to synthesize knowledge from different areas of learning, and critically and creatively apply it to real life situations. The leadership quality, co-ordination of job and maintaining good communal harmony is an important factor of this type of activity.

LEARNING OUTCOMES:

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

- Plan a Major Project
- Execute a Major Project with team.
- Implement hardware/software/analytical/numerical techniques, etc. based on project requirements.
- Optimize time related works through sharing of work responsibility
- Develop cost awareness and utilisation of fund.
- Prepare a technical report on the project.

GUIDELINES FOR MAJOR PROJECT

Unit No.	Topic/Sub-Topic
I	○ Minimum three and maximum five students can form a group for the minor project.
II	○ Project type can include • Development of a simple prototype system/product. • Investigation of performance of some systems using experimental method • Analysis of components/systems/devices using suitable software • Investigation of optimum process/material for product development using market survey. • Solution for society/industry problems

III	○ Project domain may not be limited to the specific area / discipline.
IV	○ Project report to be prepared and submitted by the students with following components: 1. Title 2. Objectives 3. Relevance and significance 4. Methodology 5. Analysis-Simulation/experimentation/survey/testing etc. 6. Result and Discussion 7. Conclusion

SEMINAR

L	T	P		
0	0	2		**Course Code: SE302**
Total Contact Hours				**Practical Assessment**
Theory		: 30Hrs	**Total Marks: 100**	End Term Exam 30
				Progressive Assessment : 70
Pre Requisite		**: Nil**		
Credit		**1**		Category of Course : SE

LEARNING OUTCOMES:

After completion of the course the students will be able to

- represent tabulated data via presentation
- represent diagram via presentation

COURSE CONTENT DETAILS

Sl. No	**Task**
1	**Technical Presentation on topics relevant to Chemical Engineering**

Suggested Home Assignments / Students' Activities: Will be decided by the respective Lecturer.

Suggested Learning Resources: Various online resources