

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW**



**Evaluation Scheme & Syllabus
For**

**B.TECH. FINAL YEAR
(CHEMICAL ENGINEERING)**

**Based On
AICTE MODEL CURRICULUM & NEP2020
(Effective from the Session: 2025-26)**

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW**

DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, LUCKNOW
B.TECH IV YEAR VII & VIII SEMESTER CHEMICAL ENGINEERING

SEMESTER- VII														
S. N.	Subject Code	Subject	Learning Mode	LTP			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BCH 701	Plant Design and Economics	Offline	3	-	-	20	10	30	-	70	-	100	3
2	BCH 071-074	Department Elective – IV	Offline	3	-	-	20	10	30	-	70	-	100	3
3	BOE***	Open Elective – II	Offline/MOOCs	3	-	-	20	10	30	-	70	-	100	3
4	BCH751	Energy and Environment Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
5	BCH752	Mini Project of Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BCH753	Project – I		0	0	10	-	-	-	150	-	-	150	5
7	BCH 754	Startup and Entrepreneurial Activity Assessment#		0	0	4	-	-	-	100	-	-	100	2
		Total		9	0	20							750	19
		PC- Program Core *The Mini Project or internship (5-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester. #The Startup and Entrepreneurial Activity Assessment will be done in 7 th semester under which a student will have to undergo a startup/entrepreneurship activity of at least 60 hours till 6 th semester												

SEMESTER- VIII														
S. N.	Subject Codes	Subject	Learning Mode	LTP			Evaluation Scheme				End Semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective – III	MOOC	3	-	-	20	10	30	-	70	-	100	3
2	BOEM**	Open Elective-IV	MOOC	3	-	-	20	10	30	-	70	-	100	3
3	BCH 851	Project – II		0	0	18				100		350	450	10
		Total		6	0	18							650	

** The Internal Assessment of MOOCs will be done by the respective institute, and the External Assessment (End Semester Examination) will be done by the University.

Department Elective - IV

BCH 071:	Energy Engineering and Management
BCH 072:	Fertilizer Technology
BCH 073:	Process Utilities and Safety
BCH 074:	Petroleum Refining Technology

List of MOOC Course offered as Open Elective – II for AY 25-26 Odd Semester Only#

MOOC Course Code	Title of Course	Faculty	Details
MEV-002	Environmental Occupational Hazards	Dr. Sushmitha Baskar and Prof. Boyina Rupini, IGNOU	Link
MEVE-013	Environmental Biotechnology	Prof. Shachi Shah, IGNOU	Link
MVP-001	Food Fundamentals and Chemistry	Dr. Mita Sinhamahapatra, IGNOU	Link
OEY-002	Renewable Energy Technology and Their Uses	Prof. Sanjay Agrawal, IGNOU	Link
	Power Generation Technologies	Prof. (Dr.) Sanjay Agrawal and Dr. Harish Ghritlahre, CSVTU	Link

subject to approval from academic council of AKTU

Subject Code: BCH 701	Course Title: Plant Design and Economics
Examination Duration: 3hrs.	Semester: VII (Odd)
L:T:P::3:0:0 Credits :3	Pre-Requisite: BCH303, BCH401, BCH501, BCH601, BCH 603
OBJECTIVE The objective of the course is to expose students to basic concepts in engineering economics, plant design, safety features and its importance to chemical engineering	
COURSE OUTCOME: On completion of this course, the students will be able to CO-1: Understand basic economics concept CO- 2: Apply this concepts in the project works undertaken and to chemical engineering situation by solving problem CO-3: Carry out the primary techno-economic feasibility of project. CO-4: Select appropriate process for a project. CO-5: Understand piping and instrumentation diagram CO-6: Evaluate the project cost including capital investment, product cost, breakeven point, depreciation cost for equipment and the total project cost.	

REFERENCE BOOKS:

S. No	Name of Authors / Books / Publishers	Year Of Publication/Reprint
1.	M.S. Peters and Timmerhaus, “Plant design and Economics for Chemical Engineers”, McGraw Hill, Inc. 4 th Edition.	1991
2.	F.C. Vibrandt and C.E. Dryden, “Chemical Engineering Plant Design”, McGraw Hill, 5 th Edition.	1959
3.	R. K. Sinnott, Chemical Engineering Design, Volume 6, Elsevier Butterworth-Heinemann, 4 th Edition.	2005
4.	V. V. Mahajani, S. M. Mokashi, Chemical Project Economics, Macmillan Publishers India Ltd., 1 st Edition, 2005.	2005
5.	O. P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications, 17th Edition, 2010.	2010
6.	Coulson & Richardson’s Chemical Engineering Volume 6, Butterworth- Heinemann, 3rd Edition.	1999

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	3	2	2	2	2	1	1	1	1	3
CO-2	2	3	3	3	2	2	1	1	1	2	3
CO-3	2	3	3	2	2	2	1	1	2	2	2
CO-4	2	2	3	2	3	1	1	1	1	2	2
CO-5	3	3	3	2	2	2	1	1	1	2	3
CO-6	2	3	2	1	1	2	1	1	-	-	-
Avg	2.3	2.8	2.3	2.0	2.0	1.8	1.0	1.0	1.0	1.5	2.1

COURSE DETAILS:

Units	Contents	Lecture Hours
I	Introduction: Basic considerations in chemical engineering plant design, optimization and feasibility of plant design. Plant location and layout: Factors affecting plant location, factors in planning layouts, principles of plant layout, use of scale models.	8
II	Process design aspects: Selection of process-factors affecting process selection. Types of project design, Importance of Laboratory development pilot plant, safety factors, types of flow diagrams. Selection of process equipment: Standard versus special equipment-material of construction for process equipment, selection criteria, and specification sheets.	8
III	Cost estimation: Cash flow and cumulative cash position for industrial operations, factors affecting estimation of investment and production cost, breakeven point and its significance, total capital investment, fixed and working capital investment & their estimations, type of estimates, cost indexes, method for estimating capital investment. Estimation of total product cost: Estimation of total product cost: manufacturing cost, general expenses, Manufacturing cost: direct production cost, fixed charges, plant overhead cost.	10
IV	Depreciation: Types of depreciation, Method for determining depreciation: straight line method, decline balance method, sum of the year digit method, shrinking fund method etc, single unit and group depreciation, adjustment of depreciation account, evaluation of depreciation methods	7
V	Profitability, alternative investments and replacement: Methods for profitability evaluation, Evaluation of Break Even Point, % rate of return, Practical factors in alternative investment and replacement Studies.	7
	TOTAL	40

Subject Code: BCH –071	Course Title: Energy Engineering & Management	
Exam Duration: 3 Hrs	Semester: VII (Odd)	
L: T:P::3:0:0 Credits: 3	Prerequisite: Nil	
COURSE OBJECTIVES: The objective of this course is to ○ Develop consciousness regarding the necessity of sustainable energy usage. ○ Learn about the environmental consequences of the extensive use of fossil fuels. ○ Expand the understanding of current and upcoming energy challenges in society.		
COURSE OUTCOME: Students completing the course will be able to CO-1: present a summary of scenarios involving renewable and non-renewable energy resources. CO- 2: to comprehend the technologies and principles that are associated with alternative energy sources CO-3: understand energy audits and their role in sustainable energy management CO-4: explore the energy conservation opportunities in chemical process utilities CO- 5: Study the various practices for Sustainable Energy Prioritization CO-6: Able to energy audits		
REFERENCE BOOKS		
S. N.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/ REPRINT
1.	Rai, G.D., Non, conventional Energy Sources, Khanna Publishers, New Delhi,	1984
2.	Dunlap, R. A., Sustainable Energy, SI Edition, Cengage Learning India Private Limited, Delhi,	2015
3.	Kothari, D. P., Singal, K. C. and Ranjan, R., —Renewable Energy Sources and Emerging Technologiesl, 2 nd Ed., PHI Learning Private Limited, Delhi,.	2011
4.	Sukhatme, S. and Nayak, J., —Solar Energy: Principles of Thermal Collection and Storagel, 4e, Tata McGraw-Hill Publishing Company Limited, New Delhi, McGraw Hill,	2017
5	Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers,	2005

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	3	3	-	-	-	-	-	-	-	-
CO-2	3	1	2	2	2	-	1	1	-	-	-
CO-3	2	3	2	1	2	2	2	1	-	-	-
CO-4	2	3	3	1	1	1	1	-	-	-	-
CO-5	2	3	1	1	-	1	-	1	-	-	-
CO-6	2	3	2	1	1	2	1	-	-	-	-
Avg	2.3	2.7	2.2	1.2	1.5	1.5	1.3	1.0	-	-	-

Course Detail

Units	Contents	Lecture Hours
I	Introduction Current Energy Scenario, Renewable and non-renewable energy, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy and Environment: Climate Change, Energy Security, Energy Conservation and its Importance	8
II	Introduction to Alternate source of energy Biomass combustion and pyrolysis, bio-gas production, Solar energy-Solar Thermal Energy: Wind Energy; Wind energy conversion systems, Geothermal energy sources and their harnessing, Ocean Thermal Energy Conversion (OTEC) and Tidal energy: Availability, theory and working principle, performance, and limitations.	8
III	Energy audit and Energy Management Objectives of energy audit, Energy audit Methodology, Types of energy audit-Preliminary and detailed, The objective of sustainable energy management, Energy policy & energy planning. Energy Strategy for the Future, Global warming.	8
IV	Energy conservation opportunities Energy conservation opportunities in chemical process utilities - Steam systems, Compressed air systems, Insulation, Cogeneration, Cogeneration systems, Waste heat recovery, Types of heat recovery equipment.	8
V	Sustainable Practices Sustainable Development Goals, Circular economy principles, Development, and Innovation in terms of circular bioeconomy, Multi-Criteria Decision-Making Approach for Sustainable Energy Prioritization, Case studies on Sustainable energy conservation technologies in chemical process industries.	8
	TOTAL	40

Subject Code: BCH 072		Course Title: Fertilizer Technology
Examination Duration: 3 Hours		Semester: VII (Odd)
L: T: P: 3:0:0 Credit: 3		Prerequisites: Chemical Technology
Objectives: • To provide comprehensive understanding of essential ingredients of fertilizers and the production processes of different fertilizers.		
Course Outcome: On successful completion of the course, the student will be able to: CO 1: Use reactions and unit operations steps in manufacturing of various fertilizers. CO 2: Select the relevant manufacturing process for different fertilizers. CO 3: Identify engineering problems in fertilizer manufacturing. CO 4: Select appropriate fertilizer on the basis of properties. CO 5: Understand the different forms of fertilizer CO 6: Understand environment need to maintain in fertilizer industry		
REFERENCE BOOKS:		
SN	Name of Authors/Books/Publisher	Year of Publication/ Reprints
1	M. Gopala Rao & Marshall Sittig, Dryden's Outlines of Chemical Technology, East-West Press, 3 rd Edition, New Delhi.	2015
2	Austin G. T, Shreve’s Chemical Process Industries, 6 th edition, Mc. Graw Hill Publications.	2023
3	Pandey & Shukla, Chemical Technology, Volume I & II, 2 nd Edition, Vani Books Company.	2018
4	John J. Mortvedt, Roy H. Follett, Larry S. Murphy, Fertilizer Technology and Application, Meister Publishing Company.	1999
5	Deepak Rajan Biswas, A textbook of fertilizer technology, New India Age Publishing, New Delhi	2021

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	3	3	1	1	1	-	-	-	-	-
CO-2	3	3	3	2	1	1	1	1	1	-	-
CO-3	2	3	2	1	2	2	2	1	-	-	-
CO-4	3	2	3	1	1	1	1	1	-	-	-
CO-5	2	3	2	2	2	1	-	1	1	-	-
CO-6	2	3	2	1	1	2	1	-	-	-	-
Avg	2.5	2.8	2.5	1.3	1.3	1.3	1.3	1.0	1.0	-	-

Course Details

Units	Contents	Lecture Hours
I	Introduction to fertilizers: Introduction to Plant nutrients, Fertilizer specifications, Terminology and Definitions, Classifications of Soil nutrients, Fundamentals of Soil Nitrogen, Soil Phosphorus, Soil Potassium and Soil Sulfur.	7
II	Nitrogenous Fertilizers: Methods of production, characteristics, storage and handling specifications of Ammonium Nitrate, Calcium Ammonium Nitrate, Ammonium Chloride, Ammonium Sulphate, Urea.	8
III	Phosphatic Fertilizers: Raw materials: Phosphate rock, Sulphur pyrites, Sulphuric acid and Phosphoric acid, Methods of production, characteristics and specifications of Single Super Phosphate, Triple Super phosphate, Ammonium Phosphates: SAP, DAP.	8
IV	Potassic Fertilizers: Methods of production, specification, characteristics of Potassium Sulphate, Potassium Chloride, Potassium Nitrate Compound Fertilizers, NPK Fertilizers, Complex Fertilizers.	8
V	Fertilizers and Environment: Environmental issues related to the use of fertilizers, impact of fertilizers on the environment, Solid, Liquid and Gaseous pollution from fertilizer industries, Bio fertilizers, Green fertilizers.	9
	Total	40

Subject Code: BCH -073		Course Title: Process Utilities and Safety
Exam duration: 3 Hours		Semester: VII (Odd)
L:T:P::3:0: 0 Credits: 3		Prerequisite: BCH - 403
COURSE OBJECTIVES: • To familiarize students with the types and importance of utilities used in chemical industries. • To develop an understanding of industrial hazards and the fundamentals of occupational health and safety. • To understand water as utility, refrigeration, compressed air systems utilities and their safety measures. • To impart knowledge on the generation, distribution, and efficient utilization of steam and power. • To equip students with methods for process hazard analysis, risk assessment, and safety management systems.		
COURSE OUTCOMES: On completion of this course student able to CO-1: Identify and analyze the role of different utilities in process industries and their impact on plant efficiency. CO-2: Explain the principles and operation of steam, power, and water utility systems and propose ways to optimize them. CO-3: Illustrate the working of refrigeration and air systems and their integration into chemical processes. CO-4: Recognize potential workplace hazards and apply safety practices including PPE, firefighting, and first aid. CO-5: Apply tools such as HAZOP, FMEA, CO-6: Understand risk assessments for process safety and evaluate case studies of major industrial accidents.		
REFERENCEBOOKS:		
S.NO.	NAME OF AUTHORS/BOOKS/PUBLISHERS	YEAR OF PUBLICATION/REPRINT
1.	Daniel A. Crowl, Joseph F. Louvar, Chemical Process Safety: Fundamentals with Applications, Pearson Education, 3rd Edition	2014
2.	Towler & Sinnott, Chemical Engineering Design, Elsevier, 3rd Edition	2021
3.	D. B. Dhone, Plant Utilities, Nirali Prakashan, 2 nd Edition	2019
4.	CCPS, Process Safety for Engineers, 2 nd Edition, Wiley	2022

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	3	3	-	-	-	-	-	-	-	-
CO-2	3	1	2	2	2	-	2	2	-	-	-
CO-3	2	1	1	2	2	1	2	1	-	-	-
CO-4	3	1	3	-	-	1	1	-	-	-	-
CO-5	2	3	1	1	-	1	-	1	-	-	-
CO-6	2	3	2	1	1	2	1	-	-	-	-
Avg	2.5	2.0	2.0	1.5	1.7	1.3	1.5	1.3	-	-	-

Course Content

UNITS	CONTENTS	LECTURE HOURS
I	Introduction to Process Utilities: Importance and Role of Utilities in Chemical Industries, Classification of Utilities: Primary and Secondary, Economics of Utilities: Cost estimation, energy efficiency, conservation, Design Considerations and Selection Criteria, Integration of Utilities with Process Operations.	8
II	Industrial Safety Fundamentals: Types of Hazards in Chemical Plants: Physical, Chemical, Biological, and Ergonomic Hazards, Hazard Identification and Risk Assessment (HIRA), Fire and Explosion Hazards: Fire triangle, Fire classes, Extinguishers, and Suppression systems, Personal Protective Equipment (PPE) and Safety Signage, Occupational Health and First Aid process in industries	8
III	Water, Air, and Refrigeration Systems: Water as a Utility: Water Treatment Methods (Softening, Demineralization, Boiler Feed Water specifications), Cooling Water Systems and their safety aspects, Safety aspects of Compressed air and vacuum systems (Compressors, blowers and vacuum pumps) and their limitations, Air Drying systems, Filtration systems, Refrigeration systems and Chilling Systems and their key safety aspects. Importance of insulation for meeting the process requirement, insulation materials and their effect on various material of equipment piping, fitting and valves etc. insulation for high, intermediate, low and subzero temperatures, including cryogenic insulation	8
IV	Steam and Power: Properties and Generation of Steam: Types of Boilers and boiler safety, Boiler Accessories and Mountings and Personal safety (PPE, Awareness of steam leaks, burns, and pressure hazards, Lock-out/tag-out (LOTO) procedures during maintenance), Steam distribution system and steam line safety, and Power Generation in Process Industries: Types of Power generation, Energy Integration and Electrical Utilities their safety measures,	8
V	Process Safety and Regulations: Process Hazard Analysis (PHA) Techniques: HAZOP, FMEA, Fault Tree Analysis, Relief and Flare Systems: Pressure Relief Valves, Rupture Discs, Design of Flare Systems, Safety Instrumented Systems (SIS) and Interlocks, Environmental and Safety Legislations: Factories Act, Environmental Protection Act, OSHA norms, Case Studies on Major Industrial Accidents (Bhopal, Flixborough etc).	8
	Total	40

Subject Code: BCH 074	Course Title: Petroleum Refining Technology	
Examination Duration: 3 Hours	Semester: VII (Odd)	
L: T: P: 3:0:0 Credit: 3	Prerequisites: Chemical Technology	
Objectives: Study the petroleum exploration and Classification of crude oils • Understand the essential products characteristics. • Develop skills in drawing neat flow diagrams of different petroleum refining processes. • Understand the final product treating operations. • Identify important testing methods for petroleum products.		
Course Outcome:: Students completing the course will be able to CO 1: Describe the process of crude oils production & refining and Characteristics of crude oils CO 2: Understand the various quality Control parameters of Petroleum Products CO 3: Understand the physical properties of petroleum products and thermal conversion of petroleum products CO 4: Understand the process involved in catalytic conversion CO 5: Demonstrate the different methods available for lube oil manufacturing process CO 6: Understand the qualitative methods in petroleum refining process		
REFERENCE BOOKS:		
SN	Name of Authors/Books/Publisher	Year of Publication/Reprints
1	Robert J. Mayer, “Handbook of Petroleum Refining Processing”, McGraw-Hill Education	2015
2	Mohamed A. Fahim, “Fundamentals of Petroleum Refining”, Elsevier science	2009
3	Bhaskara Rao B., “Modern petroleum refining processes”, oxford & IBH publishing	2018
4	Speight James G. “Handbook of Petroleum Refining”, Taylor & Francis Ltd	2016
5	Raseev S, “Thermal and Catalytic Processes in Petroleum Refining”, Taylor & Francis Ltd.	2003

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	3	3	1	1	1	-	-	-	-	-
CO-2	3	3	3	1	1	1	1	1	1	-	-
CO-3	2	3	1	1	2	2	-	1	-	-	-
CO-4	3	2	3	1	1	1	1	1	-	-	-
CO-5	2	3	1	2	1	1	-	1	1	-	-
CO-6	2	3	2	1	1	1	1	-	-	-	-
Avg	2.5	2.8	2.2	1.2	1.2	1.2	1.0	1.0	1.0	-	-

Course Details

Units	Contents	Lecture Hours
I	Introduction Petroleum Exploration: Production and Refining of Crude oils, Crude oils: Chemistry and composition (Characteristics and constituents of crude oils, classification of crude oils)	8
II	Thermal Conversion Process and Petroleum Products Crude Oil Distillation Desalting of crude oils, Atmospheric distillation of crude oil, Vacuum distillation of atmospheric residue. Composition, Properties & Specification of LPG, Naphthas, motor spirit, Kerosine, Aviation Turbine Fuels, Diesel Fuels, Fuel Oils, Petroleum Hydrocarbon Solvents, Lubricating oils (automotive engine oils, industrial lubricating oils electrical insulating oils, Jute Batching oils, white oils, steam turbine oils, metalworking oils, etc.) Petroleum Waxes Bitumen's, Petroleum coke. Thermal Conversion Process, Thermal Cracking Reactions, Thermal Cracking, Visbreaking, (Conventional Visbreaking and Soaker Visbreaking) Coking (Delayed Coking, Fluid Coking, Flexicoking), Calcination of Green Coke.	8
III	Catalytic Conversion Process Fluid catalytic cracking; Catalytic reforming; Hydrocracking catalytic Alkylation, Catalytic Isomerization; Catalytic Polymerization. Finishing Process Hydrogen sulfide removal processes; Sulphur conversion processes; Sweetening processes (Caustic treatment, Solutizer process; Doctor treating process; Copper chloride sweetening,; Hypochlorite sweetening; Air and inhibitor treating process; Merox processes; Sulphuric acid treatment; Clay treatment); Solvent extraction processes (Edeleanu process, Udex process, Sulfolane process), Hydrotreating processes.	8
IV	Quality Control of Petroleum Products Classification of laboratory tests, distillation, vapour pressure, flash and fire points, octane number, performance number, cetane number, aniline point, viscosity index, calorific value, smoke point, char value, viscosity, viscosity index, penetration tests, cloud and pour points, drop point of grease, melting and settling points of wax, softening point of Bitumen, induction period of gasoline, the thermal stability of jet fuels, gum content, Total Sulphur, Acidity and Alkalinity, Copper Strip Corrosion Test, Silver – Strip Corrosion Test for ATF, Ash, Carbon Residue (Conradson method, Ramsbottom method) Colour, Density and Specific gravity, Refractive index of hydrocarbon liquids.	8
V	Lube Oil Manufacturing Process Evaluation of crude oils for lube oil base stocks, Vacuum distillation, Solvent deasphalting Solvent extraction of lube oil fractions (Furfural, NMP and Phenol), Solvent dewaxing, Hydrofinishing, Manufacture of	8

	petroleum waxes (Wax sweating, Solvent deoiling) Manufacture of Bitumen's Selection of crude oil, Methods of manufacture of bitumens, (Distillation, Solvent precipitation, Air blowing).	
	Total	40

SUBJECTCODE: BCH 751		COURSE TITLE: ENERGY AND ENVIRONMENT LAB	
EXAMINATION DURATION: 3Hrs		SEMESTER: VI (ODD)	
L:T:P:: 0:0:2 CREDITS:1		PRE REQUISITE: NIL	
OBJECTIVES: To make students understand the basic fundamental principles of energy engineering by performing different experiments. To make them correlate theory and the practical process by experimentation.			
LABOUTCOMES: On successful completion of the course, the student will be able to Analyze the data on the properties of solid fuels. Analyze the data on the properties of liquid fuels. Write technical reports effectively with proper conclusions.			
REFERENCE BOOKS:			
S.NO.	Name of Authors/Books/Publishers	Year of Publication / Reprint	
1	Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi.	2017	
2	<u>Daniel Meeroff</u> , Environmental Science and Engineering Laboratory Manual, Kendall Hunt, 2 nd Edition.	2017	
3	Prof. Sunil S. Rao and Dr. B. B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 3 rd edition.	2024	
4	BIS Procedures/ Manuals.		

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	1	1	3	-	-	-	-	-	-	-	-
CO-2	1	1	3	2	2	1	2	2	-	-	-
CO-3	2	1	3	2	3	2	2	1	-	-	-
CO-4	2	3	3	1	1	1	1	-	-	-	-
CO-5	1	2	1	2	-	1	-	2	-	-	-
CO-6	2	3	2	1	1	2	1	-	-	-	-
Avg	1.50	1.83	2.50	1.60	1.75	1.40	1.50	1.67	-	-	-

LIST OF EXPERIMENTS

S. No.	EXPERIMENT
1	To determine the pH, turbidity, alkalinity and acidity of the sample.
2	To determine the dissolved oxygen and conductivity of the sample.
3	To determine the nitrate, phosphate and chloride of the sample.

4	To determine the residual chlorine of water sample.
5	To determine BOD of water and wastewater the sample.
6	To determine COD of water and wastewater the sample.
7	To determine flash and fire point– Pensky Martin apparatus.
8	To determine the smoke point/cloud point/pour point of liquid fuels.
9	To determine the viscosity of oil–Saybolt viscometer.
10	To determine the Calorific Value of given Liquid Fuel.
11	To determine the Volatile Content/ Moisture Content/ Ash Content in a given coal sample.
12	To determine the vapour pressure of gasoline sample using Reid method

Subject Code: BCH 752	Course Title: Mini Project of Internship Assessment
Examination Duration: --	Semester: VII (Odd)
L: T: P: 0:0:4 Credit: 2	Prerequisites: Nil
Objectives: Student is able to learn process industry practices and understanding the correlation between the theoretical and practical knowledge	
Course Outcome: Students are expected to: CO 1: understands actual process plant CO 2: correlates theoretical and practical knowledge CO 3: analyses the problems in industries CO 4: develops lifelong learning skills CO 5: develop the teamwork CO 6: apply the various engineering tools for solving complex problems	

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	2	2	1	-	2	2	2	-	-	-	3
CO-2	3	3	2	1	3	3	3	1	-	-	2
CO-3	3	1	1	-	2	3	2	1	2	-	2
CO-4	3	1	1	2	3	3	3	-	1	-	3
CO-5	2	2	-	2	2	2	3	2	2	-	2
CO-6	1	1	1	-	1	1	3	1	1	-	3
Avg	2.3	1.7	1.2	1.7	2.2	2.3	2.7	1.3	1.5	-	2.5

Course Details

- The Mini Project or internship (5-6 weeks) conducted during summer break after VI semester and will be assessed during VII semester.
- Mentor allocated to every student who will monitor the activity of a student during Industrial Training. The Mentor/Teacher shall guide and supervise the activities of the student while the student is undergoing Industrial Training.
- The Industrial Training report is to be prepared in consultation with the Mentor/Teacher and industry. Students are required to submit neatly typed and spiral bound training report after joining the college within month in 7th Term.
- The report should include information about working of the industry and specific information of the work done by the student in the industry. The students are also required to attach an Original Certificate issued by the competent authority from the industry where he/she has undergone training mentioning the successful completion of the training. The report must be duly signed by his/her Mentor.
- The students to share their experience during the Industrial training at the start of the term and assessment for the same will be made through presentation. The student is required to present the report of the skills / knowledge acquired by her/him during the training for his industrial training evaluation/TW. Report should be prepared as per the guidelines of Institute.

Subject Code: BCH 753	Course Title: Project - I
Examination Duration: --	Semester: VII (Odd)
L: T: P: 0:0:10 Credit: 5	Prerequisites: Nil
Objectives: Student is able to apply their theoretical and practical knowledge during the curriculum and solve the problem in chemical engineering	
Course Outcome: Students are expected to: CO-1: demonstrate a sound technical knowledge of their selected project topic. CO-2: undertake problem identification, formulation and solution. CO-3: design engineering solutions to complex problems utilising a systems approach. CO-4: do thermodynamic feasibility, material and energy balance of process block diagram CO-5: design and optimize major equipment's in the selected project CO-6: demonstrate the skills, knowledge, and attitudes of a professional engineer.	

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	2	2	1	2	2	1	-	-	-	1
CO-2	3	3	2	1	-	2	3	1	-	1	2
CO-3	2	2	1	-	2	2	-	1	1	1	2
CO-4	3	1	2	2	1	1	2	1	1	-	1
CO-5	2	2	2	2	2	2	2	2	2	1	2
CO-6	2	2	1	1	-	-	-	1	1	-	3
Avg	2.5	2.0	1.7	1.4	1.8	1.8	2.0	1.2	1.3	1.0	1.8

Course Details

The student can also choose a state-of-the-art problem of their own interest based on the recent trends in Chemical Engineering / Science in consultation with the guide. They shall work on the designated problem either individually or in groups (no of students in groups decides by faculty).

During the Project-I the students are required to:

1. Define the project problem.
2. Write a project proposal including concise introduction of latest published papers in the following order– a. Project title b. Introduction c. Origin of the problem d. Literature review of research and development at national & international level e. Significance of the problem f. Objective g. Methodology h. Details of collaboration (if any)
3. Carry out preliminary investigations if any or product design or process design etc.
4. Summarize the results (if any). The student is required to prepare a month wise work plan (for both semesters) immediately after the allotment of the project and the department is required to maintain a progress report of every student/project. The progress report should reflect monthly progress done by the student as per the work plan. The progress report is to be duly signed by the respective project guide by giving the remarks/marks/grades etc. on the periodic progress done by the student should submit the project report at the end of respective terms to the examiners as a supporting document for evaluation. Every student will be examined orally based on the topic of his/her project and relevant area to evaluate his understanding of the problem and the progress made by the student during the term. Students

should submit a neatly typed and spiral bound research proposal at the end of the first term in the following format. Font: Times New Roman, Font size: 12, Headings: 14, Spacing: 1.5, typed on one side of the A4 size paper with proportionate diagrams, figures, graphs, photographs, tables etc. Referencing style: 1. Guo J. X. and Gray D. G., Chiroptical behaviour of (acetyl)(ethyl)cellulose liquid-crystalline solutions in chloroform, *Macromolecules*, 22, (1989), 2086. (Reference numbers should be mentioned in the main text as a superscript) The proposal should contain: 24 Page 1: The cover page - should mention: Project title, Name of the student, Name of the guide, Exam seat number and Year. Page 2: Certificate Page 3: Index Page 4 onwards: Research proposal (as above), experimental investigation details and result if any. Last page: References The department should prepare a template of the format of the project report and supply it to the students so as to maintain the uniformity in the project reports. Students are encouraged to participate and present their project work in various events, competitions, conferences and seminars etc. in consultation with their guide.

Note: The project guides are required to educate the students about antiplagiarism policy of AKTU and apply the same while doing the project.

Subject Code: BCH 754	Course Title: Startup and Entrepreneurial Activity Assessment
Examination Duration: --	Semester: VII (Odd)
L: T: P: 0:0:4 Credit: 2	Prerequisites: BCH 753
Objectives: Student is able to understand the start and entrepreneurial policies of country and able define objective of work for start-up/entrepreneurial activity	
Course Outcome: Students are expected to: CO-1: demonstrate a sound knowledge of start-up and entrepreneurship CO-2: develop the entrepreneurship development skills CO-3: skill development of teamwork, leadership, etc CO-4: understand the policies of central and state government for start-up skill CO-5: understand entrepreneurial opportunity and enterprise planning CO-6: develop the own the business model/plan	

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	-	-	-	-	-	2	2	1	2	3	3
CO-2	1	-	-	-	-	2	3	1	2	3	2
CO-3	1	-	-	-	-	3	1	2	1	3	1
CO-4	-	-	-	-	-	1	2	2	2	2	1
CO-5	1	-	-	-	-	2	2	2	1	3	1
CO-6	-	-	-	-	-	2	1	1	1	2	2
Avg	1.0	-	-	-	-	2.0	1.8	1.5	1.5	2.7	1.7

Course Details:

- A) Institute should organize the motivational talk/workshop/seminar on the following topics in order to motivate the students for start-up/entrepreneurship
- Introduction to Entrepreneurship development
 - Entrepreneurship Development Skills
 - Various Central and State Level Organizations Which Help the Entrepreneurs, Banks and non-banking financial organisations, Fund Collection for Entrepreneurship
 - Sensing entrepreneurial opportunities, selecting the right opportunity, Site Selection, Feasibility Analysis
 - Business plan - concept, format, components of business plan. Significance of Business Plan. Making of a Business plan
- B) Student/group of students are expected to give the presentation on start-up policies of government, norms for starting business, business models, etc

- C) Institute should appoint one mentor for student or group of students to monitor the progress of the student and student should encourage to work on project/idea to convert into start-up. Student should encourage to participate in the start-up hackathon organized ministry of education, other agencies
- D) Student is expected to develop the won business model on selected topic and submit complete report of the same in format provided by institute. The report/idea should be submitted on YUKTI portal of government of India (<https://yukti.mic.gov.in/>)
- E) Assessment will be done based on the business model develop by the student in form of product/web portal/idea base presentation, etc

Subject Code: BCH 851	Course Title: Project – II
Examination Duration: --	Semester: VII (Odd)
L: T: P: 0:0:18 Credit: 10	Prerequisites: BCH 753
Objectives: Student is able to apply their theoretical and practical knowledge during the curriculum and solve the problem in chemical engineering	
Course Outcome: Students are expected to: CO-1: demonstrate a sound technical knowledge of their selected project topic. CO-2: undertake problem identification, formulation and solution. CO-3: design engineering solutions to complex problems utilising a systems approach. CO-4: do thermodynamic feasibility, material and energy balance of process block diagram CO-5: design and optimize major equipment's in the selected project CO-6: demonstrate the skills, knowledge, and attitudes of a professional engineer.	

CO-PO Mapping (1 to 3 scale)

CO/PO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO-1	3	2	2	1	2	2	1	-	-	-	1
CO-2	3	3	2	1	-	2	3	1	-	1	2
CO-3	2	2	1	-	2	2	-	1	1	1	2
CO-4	3	1	2	2	1	1	2	1	1	-	1
CO-5	2	2	2	2	2	2	2	2	2	1	2
CO-6	2	2	1	1	-	-	-	1	1	-	3
Avg	2.5	2.0	1.7	1.4	1.8	1.8	2.0	1.2	1.3	1.0	1.8

Course Details

During the second term (Project Part-II) the students are required to:

1. Carry out detailed work on previously defined (Project Part-I) project problem.
2. Write a Project Report, which should be broadly divided into the following sections define by the supervisor

Font: Times New Roman, Font size: 12, Headings: 14, Spacing: 1.5, typed on one side of the A4 size paper with proportionate diagrams, figures, graphs, photographs, tables etc. Referencing style: 2. Guo J. X. and Gray D. G., Chiroptical behavior of (acetyl)(ethyl)cellulose liquid-crystalline solutions in chloroform, Macromolecules, 22, (1989), 2086. (Reference numbers should be mentioned in the main text as a superscript)

The Project Report should contain in the following order:

1. The cover page –must mention: Project title, Name of the student(s), Name of the guide, Exam seat number and Year.
2. Certificate from guide
3. Certificate from industry (if any)
4. Index
5. Detailed Project Report having sections 'a' to 'g' from above. The student is required to prepare a month wise work plan (for both semesters) immediately after the allotment of the project and the department is required to maintain a progress report of every student/project. The progress report should reflect monthly progress done by the student as per the work plan.
The progress report is to be duly signed by the respective project guide by giving the

remarks/marks/grades etc. on the periodic progress done by the student at the mid of the term and should be submitted along with project report at the end of respective terms to the examiners as a supporting document for evaluation.

Each student is required give presentation of his work for 20 minutes using 20-22 slides. The presentation will be followed by question answer session of 5 min. The department/university will provide template of the format of the project report and supply it to the students so as to maintain the uniformity in the project reports. Students are encouraged to participate and present their project work in various events, competitions, conferences and seminars etc. in consultation with their guide.

Note: Students must check plagiarism policy of AKTU and apply the same while doing the project.