CHHATTISGARH SWAMI VIVEKANAD TECHNICAL UNIVERSITY, BHILAI (C.G.)

SCHEME OF TEACHING AND EXAMINATION
SEMESTER VIII CHEMICAL ENGINEERING

S. No	Board of Study	Subject Code	Subject	Period per week			Scheme of Exam Theory/Practical			Total Marks	Credit
				L	T	P	ESE	CT	TA		
1	Chemical Engineering	319831(19)	Process Equipment Design III	4	1	-	80	20	20	120	5
2	Chemical Engineering	319832(19)	**Modeling and Simulation**	3	1	-	80	20	20	120	4
3	Chemical Engineering	319833(19)	Process Dynamics and Control	4	1	-	80	20	20	120	5
4	**Refer Table -III**		Professional Elective-III	4	0	-	80	20	20	120	4
5	**Refer Table-IV**		Open Elective-IV	4	0	-	80	20	20	120	4
6	Chemical Engineering	319861(19)	Process Equipment Design-III Viva	-	-	3	40		20	60	2
7	Chemical Engineering	319862(19)	**Modeling and Simulation Lab**	-	-	3	40		20	60	2
8	Chemical Engineering	319863(19)	**Process Dynamics and Control Lab**	-	-	3	40		20	60	2
9	Chemical Engineering	319864(19)	Major Project	-	-	6	100		80	180	3
10	Management	319865(76)	Report Writing and Seminar	-	-	2	-		40	40	1
11	Chemical Engineering		Library	-	-	1	-		-		-
			Total	**19**	**3**	**18**	**620**	**100**	**280**	**1000**	**32**

Table – II

Professional Elective- III		
Board of Study	**Subject Code**	**Subject**
Chemical	319841(19)	**Process Economics and Management**
Chemical	319842(19)	Process Engg. & Costing
Chemical	319843(19)	Sugar Technology
Chemical	319844(19)	Pulp and Paper Technology

Note: 1. All theory papers will be of three hours duration

2. 1/4th of total strength of students subject to minimum of 20 students is required to offer an elective in the college in a particular Academic session.

3. Choice of elective course once made for an examination cannot be change in future examination.

L- Lecture, **T**- Tutorial, **P**- Practical, **ESE**- End Semester Exam, **TA**- Teacher's Assessment

Table –4

Elective -IV			
S.No.	Board of Studies	Code	Name of Subject
1	Management	300851(76)	Enterprise Resource Planning
2	Information Technology	300852(33)	E-Commerce & strategic IT
3	Management	300853(76)	Technology Management
4	Information Technology	300854(33)	Decision Support & Executive Information system
5	Computer Science & Engg.	300855(22)	Software Technology
6	Management	300856(76)	Knowledge Entrepreneurship
7	Management	300857(76)	Finance Management
8	Management	300858(76)	Project Planning, Management & Evaluation
9	Mechanical Engg.	300859(37)	Safety Engineering
10	Computer Science & Engg.	300801(22)	Bio Informatics
11	Mechanical Engg.	300802(37)	Energy Conservation & Management
12	Nanotechnology	300803(47)	Nanotechnology
13	Management	300804(36)	Intellectual Property Rights
14	Mech. Engg.	300805(37)	Value Engineering
15	Civil Engg.	300806(20)	Disaster Management
16	Civil Engg.	300807(20)	Construction Management
17	Civil Engg.	300808(20)	Ecology and Sustainable Development
18	Chem. Engg.	300809(19)	Non Conventional Energy Sources
19	Electrical Engg.	300810(24)	Energy Auditing and Management
20	Mechanical	300811(37)	Managing Innovation and Enterprenurship
21	Information Technology	300812(33)	Biometrics
22	Information Technology	300813(33)	Information Theory & Coding
23	Computer Science & Engg.	300814(22)	Supply Chain Management
24	Computer Science & Engg.	300815(22)	Internet & Web Technology
25	Electrical Engg.	300816(24)	Electrical Estimation and Costing
26	Electrical& Electronics Engg	300817(25)	Non Conventional Energy Sources

Note : 1. 1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a particular academic session.

2. Choice of elective course once made for an examination cannot be changed in future examinations.

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of Program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: **VIII**
Subject: **Process Equipment Design-III** Code: **319831(19)**
Total Theory Periods: 50 Tutorial Periods: 12
Class Test: Two(Minimum) Assignment: Two(Minimum)
ESE Duration: Four Hours Maximum Marks: 80 Minimum Marks: 28

Course Objective:

1. The course emphasizes on the development of design skill among the under-graduate Chemical Engineering students to take the design related decisions.
2. It Stress upon the design and analysis of basic process mass transfer equipments viz. Distillation Column, Absorption Column and Extraction Column etc.

Note: ***1.The candidates will be allowed to use the following in the examination hall***

- ***Chemical Engineering Hand Book- J.H Perry***
- ***Design data book duly approved***

2. Question of UNIT –I of worth 28 marks will be compulsory

UNIT-I : Design of Distillation Column

Bubble cap column: Calculation of number of trays, column diameter, flow rates of fluid, selection of tray and tray spacing, Pressure drops in tray, Design check

Sieve tray column: fluid flow properties, flooding in sieve tray column, calculation of sieve tray area, weir length weir height, tray layout including downcomer area, pressure drop in sieve tray, design check

Packed bed Distillation column: Selection of tower packing and packing material, calculation of calculation of mass transfer coefficient, calculation of tower height using HTU methods,

UNIT-II : Design of Packed bed Absorption column:

Calculation of fluid properties, mass transfer coefficient for both liquid and gaseous phase, Selection of packing material, calculation of absorption factor, calculation of height of tower using HTU methods, checking for flooding velocity, pressure drop calculation, Design check

UNIT-III : Design of spray Extraction column: Calculation of dispersed phase and continuous phase fluid properties, finding drop diameter and drop sizes, calculation of tower diameter, pressures drop calculations, design check

Sieve tray extraction column: column sizing approximation, column diameter, hole diameter, hole pitch and thickness, weir height and weir length, tray layout including down comer area, active area, perforated area, weeping rate, plate pressure drop, design check

Text Books:

1. Ludwig, E., " Petrochemical Plant Design", Volume-II
2. Treybal, R.E., " Mass Transfer Operations", McGraw Hill International Edition, 3rd Ed., 1998

Reference Books:

1. Perry J.H., " Chemical Engineering Hand Book", McGraw Hill International Edition
2. Brownell, L.E., Young, E.H.," Process Equipment Design", John Wiley and Sons Publications, 2004
3. Bhattacharya, B.C.," Introduction to Chemical Engineering Equipment Design", CBS publisher and distributer, 2003

Course Outcome:

1.The course of Process Equipment Design-III is designed in such a manner so as to give chemical engineering students up-to date knowledge of designing process equipments generally used in chemical industries.

2. The course contains lots of numerical design examples and problems so that the students may properly understand the subject and apply the knowledge after their graduation in industries and higher studies.

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Name of program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: **VIII**
Subject: **Modeling & Simulation** Code: **319832(19)**
Total Theory Periods: 40 Total Tutorial Periods: 10
Class Tests: **Two (Minimum)** Assignments: **Two (Minimum)**
ESE Duration: **Three Hours** Maximum Marks: **80 Minimum Marks: 28**

Course Objectives:

1. To give an overview of various methods of process modeling, different computational techniques for simulation.
2. The focus shall be on the techniques themselves, rather than specific applications so that the student can take up modeling and simulation challenges in his profession.

Course outcomes:

1. Solving the problems using MATLAB/SCILAB.TEXT BOOKS:
2. Upon completing the course, the student should have understood Development of process models based on conservation principles and process data
3. Computational techniques to solve the process models, how to use simulation tools such as MATLAB/SCILAB.

UNIT- I Introduction and fundamentals of process modeling and simulation: Need for modeling, Types of process models, Lumped and distributed parameter systems, Fundamental laws, Total continuity and component continuity equations, Energy equation, Equations of motion, Transport equations, Equations of state, Equilibrium, Chemical kinetics..

UNIT- II Mathematical models of chemical engineering systems: Series of isothermal, constant holdup CSTRs, CSTRs with variable holdups, Two heated tanks, Gas-phase pressurized CSTR, Non-isothermal CSTR, Single component vaporizer, Multi-component flash drum, Batch reactor, Ideal Binary distillation column, pH systems, absorption column.

UNIT- III Numerical Techniques for Computer simulation: Linear algebraic equations, non-linear algebraic equations, Ordinary differential equations, Partial differential equations.

UNIT- IV Simulation examples: Gravity flow tank, Three CSTRs in series, Heat transfer equipments, Stirred tank heaters,

UNIT- V Chemical process simulation flow sheeting, Commercial steady state and dynamic simulators, Empirical black-box models, Introduction to application of advanced modeling methods like Artificial Neural Networks (ANN)

Text Books:

1. K. M. Hangos and I. T. Cameron, “Process Modeling and Model Analysis”,Academic Press, 2001.
2. W.L. Luyben, “Process Modeling, Simulation and Control for Chemical Engineers”,2ndEdn., McGraw Hill Book Co., New York, 1990.
3. Singiresu S. Rao, “Applied Numerical Methods for Engineers and Scientists”Prentice Hall, Upper Saddle River, NJ, 2001

Reference Books:

1. Bruce A. Finlayson, Introduction to Chemical Engineering Computing, Wiley, 2010.
2. W. F. Ramirez, “Computational Methods for Process Simulation”, 2nd ed.,Butterworths, 1997
3. Laurene V. Fausett, Applied Numerical Analysis using MATLAB, Second edition,Pearson, 2009

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: VIII
Subject: **Process Dynamics and Control** Code: **319833(19)**
Total Theory Periods: **50** Total Tutorial Periods: **12**
Class Tests: **Two (Minimum)** Assignments: **Two (Minimum)**
ESE Duration: **Three Hours** **Maximum Marks: 80** **Minimum Marks: 28**

Course Objectives:

1. This course aims at giving the students the perspective of process dynamics and the necessary theory and practice for the design and operation of process control systems.
2. This course enables the students to know about control methods.
3. This course makes the students knowledgeable in various control problems and their solutions.

Course outcomes:

1. Understand the different control methods
2. Know how to choose industrial control equipment
3. Know how to tune feedback and feed forward control systems
4. Be able to participate in the design of an industrial distributed control system

UNIT-I Laplace Transform, Linear Open Loop Systems: Response of First Order Systems, Physical Examples of First Order Systems, Response of First Order Systems in Series: Interacting & Non-interacting systems, Linearization

UNIT-II Analysis of Dynamic Behavior of Second Order Control Systems: Response Equations, Transportation lag, Linear closed loop systems: control system, block diagram, Servo problem, regulator problem, Development of block diagram.

UNIT-III Pneumatic controller mechanism & dynamic behavior: Proportional controller mechanism, proportional integral controller mechanism, proportional derivative controller mechanism, proportional integral derivative controller mechanism, Final control element, control valves

UNIT-IV Stability Analysis of Control System: Concept of Stability, Stability criterion, characteristic equation, Rout-Hurwitz Criterion for Stability, Limitation of Routh- Hurwitz Criterion

UNIT-V Concept of Root locus, Plotting of Root Locus Diagram, Frequency Response: Introduction to Frequency Response, Control System Design by Frequency Response: Bode diagram, Bode stability criterion Gain & Phase Margin, Ziegler-Nichols Controller Settings.

Text Books:

1. Donald R. Coughanowr, Process Systems Analysis and Control, McGraw-Hill International Editions
2. George Stephanopoulos, Chemical Process Control, Pearson Education

Reference Books:

1. R. P. Vyas, Process Control & Instrumentation, Central Techno Publications
2. B.S.Manke, Linear Control Systems
3. Gaikwad R.W., Process Dynamics & Control, Central Techno Publication

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program:	**Bachelor of Engineering**		
Branch:	**Chemical Engineering**	Semester:	**VIII**
Subject:	**Process Equipment Design-III Viva**	Practical Code:	**319861(19)**
Total Practical periods:	**40**	Total ESE Marks:	**40**
Batch Size:	**15**		

Viva- Voice Examination Based on Syllabus for Process Equipment Design-III Theory, to be conducted

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI

Semester: VIII Branch: Chemical Engineering

Subject: **Modeling and Simulation Lab** Code:**319862(19)**

Total Practical Periods: 40

Total Marks in End Semester Exam: 40

Experiments to be performed: (Minimum 10) Using MATLAB

1. Write a program to find out a root of a linear equation using Bisection method.
2. Write a program to find out a root of a linear equation using Regula Falsi Method.
3. Write a program to find out a root of a linear equation using Newton Raphson method.
4. Write a program to solve linear algebraic equation using Gauss Seidal method/Jacobis method.
5. Generate an exponential empirical equation through 2 sets of numerical data.
6. Generate a logarithmic empirical equation through 2 sets of numerical data.
7. Generate a polynomial empirical equation through 2 sets of numerical data.
8. Calculate LMTD through MATLAB.
9. Calculate Reynolds number when diameter, density and viscosity remain constant but velocity ranges from 1 to 100.
10. Calculate Nusselt number when Reynolds number ranges from 2000 to 10000 and Prandtl number ranges from 0.25 to 0.65.
11. Write a program for matrix multiplication.
12. Write a program for matrix inversion.
13. Graph preparation in 2D and 3D using MATLAB.
14. Matrix operation using MATLAB.

Name of Reference Books:

1. Rudra Pratap," *Getting Started with MATLAB",* Oxford University Press, USA, Edition 2009.
2. Marc E. Herniter,"Programming in MATLAB,Thomson Learning,1st Edition.
3. Parth S Mallick,"MATLAB and SIMULINK"scitech publication pvt. Ltd.3rd edition.

Chhattisgarh Swami Vivekanand Technical University, Bhilai (c.g.)

Name of program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: **VIII**
Subject: **Process Dynamics and Control Lab** Code: **319863(19)**
Total lab Periods: **40** Batch Size: **15**
Maximum Marks**:** **40** Minimum Marks: **20**

List of Experiments*:* (At least Ten experiments are to be performed by each student)

1. Determination of the time constant of mercury in glass thermometer in hot water-air system for first order system.
2. Determination of the time constant of mercury thermometer in ice cold water - air system for first order system.
3. Determination of the time constant of mercury thermometer in mobile oil - air system for first order system.
4. Study of response characteristics of the pressure control for first order system.
5. Study of response characteristics of the flow control for first order system.
6. Study of response characteristics of the level control for first order system
7. Study of response characteristics of mercury in glass thermometer in hot water-air system for first order system.
8. Study of response characteristics of mercury thermometer in ice cold water - air system for first order system.
9. Study of response characteristics of mercury thermometer in mobile oil - air system for first order system
10. Determination of the time constant of thermocouple in hot water-air system for first order system.
11. Determination of the time constant of thermocouple in mobile oil - air system for first order system.
12. Determination of the time constant of thermocouple in ice cold water - air system for first order system.
13. Study of response characteristics of Computerized Closed Loop Flow Control System.
14. Study of response characteristics of Computerized Closed Loop Level Control System.
15. Study of Study of response characteristics of Computerized Closed Loop Pressure Control System.
16. Study of response characteristics of Computerized Closed Loop Temperature Control System.
17. Study of response characteristics of Computerized Closed Loop Interacting Tank
18. Study of response characteristics of Computerized Closed Loop Non Interacting Tank.

Equipment/Machines/Instruments/Tools/Software Required:

1. Computerized Closed Loop Flow Control System.
2. Computerized Closed Loop Level Control System.
3. Computerized Closed Loop Pressure Control System.
4. Computerized Closed Loop Temperature Control System.
5. Computerized Closed Loop Interacting Tank
6. Computerized Closed Loop Non Interacting Tank.
7. Water bath
8. Thermometer & Thermocouple

Recommended Books:

1. Coughanowr , Process System Analysis and Control
2. Stephanopoulos , Chemical Engineering Process Control
3. Vyas R.P., Instrumentation and Process Control

Chhattisgarh Swami Vivekanand Technical University, Bhilai

Name of program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: **VIII**
Subject: **Non Conventional Energy Sources** Subject Code: 300809(19)
Class Tests: **Two (Minimum)** **Maximum Marks: 80 Minimum Marks: 28**
Total Theory Periods: **40**
ESE Duration: **Three Hours**

Note: Internal choices may be given in any three units.

Course Objectives: Energy is the key input to drive and improve the life cycle. The primary source of energy is fossil fuel, however the finiteness of fossil fuel reserves and large scale environmental degradation caused by their widespread use, particularly global warming, urban air pollution and acid rain, strongly suggests that harnessing of non-conventional, renewable and environment friendly energy resources is vital for steering the global energy supplies towards a sustainable path. This subject describes in brief such non-conventional energy sources and their usage.

Unit I An introduction to energy sources, Environmental Aspects of Power Generation.
Heat Transfer from **Solar Energy**, Physical principles of conversion of solar radiation into heat utilization, Flat Plate Collectors (FPC), Thermal losses and efficiency of FPC, Practical considerations for flat plate collectors, Applications of FPC – Water heating and drying, Focusing Type Collectors: orientation and sun tracking systems, Types of concentrating collectors – cylindrical parabolic collector, compound parabolic collector, Thermal performance of focusing collectors,

Unit II **Solar energy** storage system, Application of solar energy: solar water heating, space heating and cooling, solar photovoltaic, solar cooking, solar distillation & desalination , Solar industrial process heating, Solar power generation. Solar Green Houses, Solar thermo mechanical power, solar refrigeration & air conditioning, Solar ponds.

Unit III **Energy from Biomass**: Type of biomass sources, Energy plantation, Methods for obtaining energy from biomass, Biomass conversion technologies-wet and dry processes, Biodigestion, Community/Industrial biogas plants, Factors affecting biodigestion, Design of a biogas plant, Classification, advantages and disadvantages of biogas plants, Problems related to biogas plants, Utilization of biogas.
Thermal gasification of biomass, Gasifier- classification, chemistry, advantages, disadvantages and application.
Alcohol fuels from biomass: overview, feedstock, methods for alcohol production, Ethanol as an alternative liquid fuel; engine performance with alcohol fuels, biodiesel from biomass.

Unit IV **Wind Energy**: Basic principles of wind energy conversion: power in the wind, maximum power, forces on the blades, lift and drag, Components of wind energy conversion systems (WEC), Classification, advantages and disadvantages of WEC systems, Types of wind machines, Performance of wind machines, Design considerations, Energy storage, Application of wind energy, Environmental aspect.
Tidal Energy. Components of tidal power plants, Single and double basin arrangements, Estimation of energy and power, Advantages and limitations of tidal power.
Wave energy- its advantages and disadvantages, energy and power from wave energy.

Unit V **Chemical Energy Sources**: Fuel cells: Design, principle, classification, types, advantages and disadvantages, Work output and EMF of fuel cells, Application of fuel cells, Hydrogen energy, Properties of hydrogen, Methods of hydrogen production, Storage and transportation of hydrogen, Advantages and application.

Text Books:

1. G D Rai, 'Non-Conventional Energy Sources', Khanna Publishers. Delhi, 2010
2. S P Sukhatme, 'Solar Energy-Principles of Thermal Collection & Storage', Tata McGraw Hill Publishing Company Ltd., New Delhi

Reference Books

1. John A Duffie & William A Beckman, 'Solar Energy Thermal processes', Wiley Interscience publication .
2. P Garg & J Prakash,' Solar Energy - Fundamentals and Applications', Wiley Interscience publication.

3. Jay Cheng, 'Biomass to Renewable Energy Processes', 1st Edition, CRC press, 2009.

Course Outcomes:
At the end of the course, the student will be able to:
1. Address smart energy and green infrastructure
2. Build models that simulate sustainable and renewable green technology systems
3. Understand the history, global, environmental and economical impacts of green technology
4. Address non renewable energy challenges

Chhattisgarh Swami Vivekananda Technical University, Bhilai

Name of program: **Bachelor of Engineering**
Branch: **Chemical Engineering** Semester: **VIII**
Subject: **Process Economics and Management** Code: **319841(19)**
Total Theory Period: **40** Total Tutorial Period:
Class Tests: **Two (Minimum)** Assignments: **Two (Minimum)**
Duration: **Three Hours** Maximum Marks: **80** **Minimum Marks: 28**

Course Objectives:

1. To know about organization, their types structure and process.
2. To understand the ownership like private, public and joint.
3. To study the concept of management.
4. To understand the depreciation.
5. To understand cost accounting and control.

Course Outcomes:

1. The Student will be able to understand the necessity of organization.
2. The Student will be able to understand the forms of business organization.
3. The Student will be able to understand the Act & Laws.
4. The Student will be able to understand the cost control.

Unit 1 Organization: Introduction, System Approach Applied To Organization, Necessity of Organization, Process of Organization, Formal and Informal Organization, Organization Structure and Types.

Unit 2 Forms of Business Organization: Concept andTypes of Ownership, Industrial Ownership, Partnership Organization, Joint Stock Company, Co-Operative Organization, Public Sector Organization, and State Ownership.

Unit 3 Management: Concept Of Management, Function Of Management, Financial Management. IndustrialActs And Legislations: Factories Act, Workmen's Compensation Act, Wages Act Employee's Provident Fund and Family Pension Act

Unit 4 Finance: Breakeven Analysis, Breakeven Point, Breakeven Calculation and Applications. Depreciation: Introduction, Types, Methods for Calculating Depreciation Fund.

Unit 5 Cost Accounting and Control: Cost Estimation, Elements Of Cost, Computation Of Actual Cost, Nature And Types Of Cost, Cost Control, Replacement Studies: Methods (Rate Of Return, Payback Period, And Discounted Cash Flow)

Name of the Text Books:

1. BangaT.R.,Sharma S.C.,Agarwal N.K. "Industrial Engineering and Management Science" Khanna Publication, 10th Edition 2007
2. MahajanM.S.,"Industrial Engineering & Production Management" DhanpatRai Publication, 1st Edition 2000-01

Name of Reference Books:

1. Khanna O.P. "Industrial Engineering & Management" DhanapatRai Publication, Revised & Enlarged Edition 2007
2. Peter S. Max, Timmerhaus D. Klaus, West E. Ronald ,"Plant Design & Economics for Chemical Engineers" , Tata McgrawHill,5th Edition 2004

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Name of program: **Bachelor of Engineering** Semester: **VIII**
Branch: **Chemical Engineering** Code: **319842(19)**
Subject: **Process Engineering and Costing**
Total Theory Periods: **50** Total Tutorial Periods: **NIL**
Class Tests: **Two (Minimum)** Assignment: **Two (Minimum)**
ESE Duration: **Three Hours** **Maximum Marks: 80** **Minimum Marks: 28**

Course Objectives:

1. The aim of the course is to study about capital requirements and overall cost analysis for process plants.
2. The purpose of the course is to study the cost, earnings, profits and returns of any industry.

Course Outcomes:

1. After undergoing this course the students will acquire knowledge regarding overall cost analysis for process plants.
2. After undergoing this course the students will acquire knowledge about earnings, profits and returns of any industry.

Unit I Value Of Money: Equivalence, Equations for economic studies and equivalence, Amortization Capital recovery, Depreciation.

Unit II Capital Requirements For Process Plants: Project implementation steps, Feasibility studies, Capital requirements for process plants, Cost indices, Equipment cost, Service facilities, Capital requirements for complete plants, Balance sheet.

Unit III Cost, Earnings, Profits And Returns: Variable cost, Fixed cost, Income statement, Economic production charts, Capacity factors, Taxes and insurance.

Unit IV Economics of Selecting Alternates: Annual cost method, Present worth method,Equivalent Alternates, Rate of return and payment time, Cash flow analysis.

Unit V Overall Cost Analysis And Economic Trade Offs: Economic balance in batch operations, Utility cost, Overhead cost, Plant layout & overall cost analysis for the plant, Economic trade offs.

Text Books:

1. Peters M. S. and Timmerhaus K. D. “Plant Design and Economics for Chemical Engineers”, McGraw Hill book Co., New York, 1991
2. Schwyer H. E. “Process Engineering Economics”, McGraw Hill Book Co., New York, 1955.

Reference Books:

1. Jelen F.C., “Cost and Optimization Engineering”, McGraw Hill Book Co., New York, 1970.
2. Smith Robin “Chemical Process Design”, McGraw Hill Book Co., New York, 1995.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Name of program: **Bachelor of Engineering** Semester: **VIII**
Branch: **Chemical Engineering** Code: **319843(19)**
Subject: **Sugar Technology**
Total Theory Periods: **50** Total Tutorial Periods: **NIL**
Class Tests: **Two (Minimum)** Assignment: **Two (Minimum)**
ESE Duration: **Three Hours** **Maximum Marks: 80** **Minimum Marks: 28**

Course Objectives:

1. The aim of the course is to study about sugar manufacturing processes.
2. The purpose of the course is to study the refining process, quality control and purification methods.

Course Outcomes:

1. After undergoing this course the students will acquire knowledge regarding sugar manufacturing processes their refining process, quality control and purification methods.

Unit I Historical review of sugar technology, Manufacture of sugar from cane, beet and starchy materials, By products of sugar, Refining of sugar.

Unit II Analysis of sugar by physical, chemical and chromatographic methods- purity and color determination.

Unit III Chemical processes in sugar manufacturing: Sulphitation, clarification, evaporation, crystallization, centrifuging, packing, storing and shipping.

Unit IV Manufacture of sugar from beet, Purification with lime and carbon dioxide/carbonation, Steffan process for desugaring from molasses.

Unit V Manufacture of starch, By product manufacture: alcohol, biogas from spent wash, paper from bagasse.

Text Books:

1. Austin , George T., “Shreve’s Chemical Process Industries” , 5th Ed., McGraw Hill Book Company.
2. Bhatia S.C., “Chemical Process Industries”, Vol. II , CBS Publishers and Distributors.
3. Pandey G.N., “A Textbook of Chemical Technology”, Vol. II , Vikas Publishing House Pvt. Ltd.

Reference Books:

1. Honig P., Principles of Sugar Technology , 3 Vols., Elsevier ,New York , 1962.
2. Panacost H.M., and W.R.Junk , Handbook of Sugars, 2nd Ed., Avi , Westport , Conn., 1980.
3. Vukov K., Physics and Chemistry of Sugar Beet in Sugar Manufacture.

Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.)

Name of program: **Bachelor of Engineering** Semester: **VIII**
Branch: **Chemical Engineering** Code: **319844(19)**
Subject: **Pulp and Paper Technology**
Total Theory Periods: **50** Total Tutorial Periods: **NIL**
Class Tests: **Two (Minimum)** Assignment: **Two (Minimum)**
ESE Duration: **Three Hours** **Maximum Marks: 80** **Minimum Marks: 28**

Course Objectives:

3. The aim of the course is to study about pulping technology.
4. The purpose of the course is to study the treatment, cleaning and bleaching process of pulp.

Course Outcomes:

1. After undergoing this course the students will acquire knowledge regarding pulping technology.
2. After undergoing this course the students will acquire knowledge about treatment, cleaning and bleaching process of pulp.

Unit I **Pulping:** Introduction of pulping, Overview of pulping operation, batch and continuous Digesters, direct and indirect heating, reaction kinetics, H-factor, transport phenomena during pulping, G factor, Extended delignification, Rapid displacement heating (RDH), Blow heat recovery, Introduction of washing, Transport Phenomena during washing, Diffusion vs. displacement, Single and multistage washing, Counter current rotary drum washers, Dilution factor, Displacement ratio, Washing capacity and efficiency, Soda loss, Material and flow balances for systems with recycle.

Unit II **Screening and Cleaning:** Introduction, Objectives and Theory, Screening system process design, Centrifugal Cleaners : Forward and reverse cleaners, Principles of operation, Drag vs. centrifugal force, Design and operating parameters, Screening and cleaning efficiency for multistage systems, Material and flow balances for systems with recycle, Bleaching: Transport phenomena during bleaching, Mixers, Pumps, design and operation of bleach tower, Up flow vs. down flow towers, Washing after bleaching.

Unit III **Chemical Recovery:** Kraft Recovery Process, Introduction, Overview of kraft recovery, Recovery cycle, Properties of black liquor :Composition, Density or specific gravity, Total solids, Viscosity, Thermal conductivity, Specific heat, Boiling point, Boiling point rise (BPR), Heating value: Higher and lower heating value, Evaporation, Process requirements, Single effect and multiple effect evaporators (MEE), Mass and energy balances in MEE, Multiple effect analysis: Capacity, Steam economy, Vapor recompression evaporators. Scaling and scale control.

Unit IV **Chemical Recovery:** Black Liquor combustion ,Drying, Pyrolysis, Char combustion, Particle entrainment, Recovery boiler equipment: Furnace, Liquor spray, Combustion air system, Smelt, Convective heat transfer, Boiler capacity, Mass and energy balances, Chemical recovery : Slaking and causticizing, Causticizing rates, Separation processes: Sedimentation, Filtration, Separation variables, Clarifier design and operation, Material balances, Lime reburning, Calcining lime mud, Rotary lime kiln, Mass and energy balances, Fluidized bed calciners.

Unit V Stock preparation, Additives and conversion of pulp to paper.

Text Books:

1. G. N. Pandey , “Chemical Tech.”Vol II.
2. Gopala Rao M. and Marshall S.,“ Dryden’s Outlines of Chemical Technology ”,East-West Press Pvt Ltd.

Reference Books:

1. Pulp and Paper, 3rd edition Vol I, II, III and IV Wiley International New York.
2. Hand book of Pulp and Paper Technology, Vannostrand New York.