UNIVERSITY OF MUMBAI
No.UG / 402 of 2008

CIRCULAR :-

A reference is ited to the Ordinances, Regulations and syllabi relating to the Master of Engineerir (Chemical Engineering) and the Principals of the affiliated collages in Engineeri are hereby informed that the recommendation made by the Faculty of Technology its meeting held on 26th March, 2008 has been accepted by the Academic Council at i eeting held on 15th April, 2008 **vide** item No.4.26 and that, in accordance therewith, he M.E.(Chemical Engineering) degree course has been introduced by the Univ ity and that the syllabus and scheme of Examinations for M.E. (Chemical Engineering) Sem.I to IV) degree course is as per **Appendix** and that the same has been brought o force with effect from the academic year 2008-2009.

MUMBAI-400 032
29th August, 2008

PRIN.K.VENKATARAMANI
REGISTRAR

To,

The Principals the affiliated colleges in Engineering.

.C./4. 26/15.04.2008

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o.UG/402- A of 2008, MUMBAI-400 032 29th August, 2008

opy forwarded with compliments for information to :-

1) The Dean, Faculty f Technology.
2) The Chairman, Ad-oc Board of Studies in Chemical Engineering .
3) The Controller of Eaminations,
4) The Co-Ordinator, Iniversity Computerization Centre,

29/08/08

(D. H .KATE)
DEPUTY REGISTRAR
(U.G./P.G.Section.)

29/8

to :-

The Director, Board of Colle e and University Development, , the Deputy Registrar (Eligibility and Mig), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancello r and the Assistant Registrar, Administrative sub-center, Ratnagiri for information .

The Controller of Examinatios (10 copies), the Finance and Accounts Officer (2 copies), Record Section s), Publications Section (5 coies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 cop Registrar, Statistical Unit (2 opies), the Deputy Registrar (Accounts Section),Vidyanagari (2 copies), the ; Affiliation Section (2 copis), the Director, Institute of Distance Education,(10 copies) the Director U r Center (IDE Building), Vidyanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registra tant Registrar, Academic Autorities Unit (2 copies)and the Assistant Registrar, Executive Authorities Unit (requested to treat this as actin taken report on the conce ned resolution adopted by the Academic Council re ove Circular and that, no sparate Action Taken Report will be sent in this connection. the Assistant nt Colleges Unit (2 copies), UCT(1 copy), the Deputy Account, Unit V(1 copy), the In-charge Dire hic ig Facility (1 copy), the Rec ptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 ndent, Post-Graduate Sectio (2 copies), the Superintendent, Thesis Section (2 copies)

Enclosure to Item No. 4.26
15.4.2008.

UNIVERSITY OF MUMBAI

Syllabus and Scheme of
Instructions and Examinations
For
M.E.(Chemical Engineering)
(Sem.I to IV)
degree course

(Introduced with effect from the academic year 2008-2009)

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

UNIVERSITY OF MUMBAI

COURSE: ME (CHEMICAL ENGINEERING) **SEMESTER: I**

S. No.	Subject	Scheme of Instructions 1 Hr. Periods	Duration of Papers Hrs	Scheme of Examination			
		Lecture		Theory Paper	Term Work / Assignment	Seminar	Total
1.1	Advanced Fluid Dynamics	3	3	100	25	25	150
1.2	Advanced Reaction Engineering	3	3	100	25	25	150
1.3	Advanced Thermodynamics	3	3	100	25	25	150
1.4	Environmental Engineering	3	3	100	25	25	150
1.5	Elective - I	3	3	100	25	25	150
	TOTAL	**15**		**500**	**125**	**125**	**750**

Elective – I: 1. Energy Audit and Conservation in Process Industries

2. Chemical Process Sythesis

3. Petroleum Refining

COURSE: ME (CHEMICAL ENGINEERING) **SEMESTER: II**

S. No.	Subject	Scheme of Instructions 1 Hr. Periods	Duration of Papers Hrs	Scheme of Examination			
		Lecture		Theory Paper	Term Work / Assignment	Seminar	Total
2.1	Advanced Mass Transfer	3	3	100	25	25	150
2.2	Advanced Process Dynamics & Control	3	3	100	25	25	150
2.3	Advanced Computer Aided Design	3	3	100	25	25	150
2.4	Process Heat Transfer	3	3	100	25	25	150
2.5	Elective - II	3	3	100	25	25	150
	TOTAL	**15**		**500**	**125**	**125**	**750**

Elective – II 1. Advanced Separation Techniques

2. Polymerization Reaction Engineering

3. Corrosion in Industry and It's Control

COURSE: ME (CHEMICAL ENGINEERING) **SEMESTER: III**

S. No.	Subject	Scheme of Instructions 1 Hr. Periods	Duration of Papers Hrs	Scheme of Examination		
		Lecture		Theory Paper	Term Work / Assignment	Semina
3.1	Project – I	4	-	-	-	50
3.2	Seminar	2	-	-	25	25
	TOTAL	**6**	**-**	**-**	**25**	**75**

COURSE: ME (CHEMICAL ENGINEERING) **SEMESTER: IV**

S. No.	Subject	Scheme of Instructions 1 Hr. Periods	Duration of Papers Hrs	Scheme of Examination		
		Lecture		Theory Paper	Term Work / Assignment	Seminar
4.1	Project – II	6	-	-	100	100
	TOTAL	**6**	**-**	**-**	**100**	**100**

CLASS: M.E. CHEMICAL ENGINEERING		Semester – I	
SUBJECT: Advanced Fluid Dynamics			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Compressible Fluids, Non-Newtonian fluids, Agitation and Mixing, Phase separation and setting Behavior. Description of a two phase system. Slip and hold up effect, Horizontal and vertical flows of gas liquids, liquid, gas-solid mixtures, Motion in the fluidized bed, Jets and Sprays

Reference Books :

Govier and Aziz, The flow of Complex mixtures in Pipes, Van Nostrand Reinhold, New York (1972).

SS. M.E. CHEMICAL ENGINEERING		Semester – I	
ECT: Advanced Reaction Engineering			
ds Per Week h of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
uation System	**Theory Examination**	**03**	**100**
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		**25**
	Seminar		**25**
	Total		**150**

Detailed Syllabus

RTD for Chemical Reactors

General characteristics, Measurement of RTD characteristics, RTD in Ideal Reactors, Zero Parameter Models; Segregation Model

Analysis of Non – Ideal reactors

Basic Data, one parameter Models. The tank in the series Models, The dispersion model, two parameter model, Testing in the model and determining its parameters, Other models of the non ideal reactors using the CSTR's and PFRs using the RTD

Rate equation for Fluid- Solid reactions

Rate of the absorption, desorption, surface reaction, synthesizing rate law, mechanism and rate limiting steps, design of the reactors for the gas solid reactions, heterogeneous data analysis for the reactor designs, catalysts deactivation moving bed reactors

External diffusing effects on the Heterogeneous Reactions

Binary diffusion, External resistance to Mass Transfer, The shrinking core model

Diffusion and Reaction in Porous Catalysts

Diffusion and reactions in spherical catalysts pellets, Internal effectiveness factor, Flasefied kinetics, Overall effectiveness factor, Estimation of diffusion and reaction limited regimes, mass transfer and reaction in packed bed, The determination of limited situation from reaction data

Design of Heterogeneous Catalytic Reactors

Isothermal and adiabatic fixed bed reactors, Non-Isothermal, Non-adiabatic fixed bed reactors, slurry reactors, trickle bed reactors

Reference Books :

H.Scott Foggler, Element of Chemical Reaction Engineering, 2nd addition, Prentice Hall of India.

J.M. Smith, Chemical Engineering Kinetics, 3rd edition, Mc Graw Hill publications

J.Canberry, Chemical and Catalytic Reaction engineering, Mc Graw Hill publications.

ASS: M.E. CHEMICAL ENGINEERING		Semester – I	
BJECT: Advanced Thermodynamics			
iods Per Week ch of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
aluation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Application of Thermodynamics to Phase Equilibrium

Homogeneous and heterogeneous system, phase rule, chemical partial, fugacity and activity, Thermodynamic properties from metric data

Fugacities in gas mixtures

Lewis fugacity rule, virial equation of state, fugacities, virial equation, virial coefficients

Fugacities in liquid mixtures

Ideal solution, excess functions, activity and activity coefficients, activity coefficients from excess function

Theory of solution

Vanlarr theory, Scatchard – Hildebrand theory, lattice theory corresponding states theory

Solubilities

Gases in liquids, solids in liquids

Reference Books: J.M. Prausnit, Molecular Thermodynamics of Fluid-Phase Equilibria, Prentice Hall Inc. New Jersey.

SS: M.E. CHEMICAL ENGINEERING		Semester – I	
JECT: Environmental Engineering			
ods Per Week ch of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
uation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments	-	25
	Seminar		25
	Total		150

Detailed Syllabus

Pollution and its measurement

Introduction, Analysis of Pollutants

Pollution control for specific Pollutants

Removal of BOD, Removal of chromium, Removal of mercury, Removal of ammonia/urea, Treatment of phenolic effluents, Removal of particulate matter, removal of sulphur dioxide, Removal of oxided of nitrogen, Removal of organic vapour from effluent gases

Pollution control in selected process industries

General consideration of pollution control in chemical industries, Pollution control aspects of fertilizer industries, Pollution control in petroleum refineries and petrochemical units, Pollution control in paper industries, Miscellaneous industries

Reference Books :

A. Mahajan, Pollution Control in process Industries (1985), McGraw Hill publishing Co.

CLASS: M.E. CHEMICAL ENGINEERING		Semester – I	
SUBJECT: Elective I 1. Energy Audit and Conservation in Process Industries			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Introduction

Energy outlook, The second law of Thermodynamics revisited

Thermodynamics and Economics Part I

Characterizing Energy use (Energy – Audit), Optimum performance of existing facilities, Facilities improvement, Methodology of Thermodynamic analysis, Detailed Thermodynamics analysis of common unit operations, Use Thermodynamic analysis to improve energy efficiency

Thermodynamics and Economics part II

Systematic Design methods, Guidelines and recommendations for improving process operation

Reference Books :

W. F. Kenny, Energy Conservation in the Process Industries (1984), Academic Press Inc. (London) Ltd.

Practical Technique for saving Energy in Chemical, Petroleum and Meta industries, (1977), Noyes Data Operations.

N. Boustead, G. F. Hancock, Handbook of Industrial Energy Analysis (1979), Elli Horwood Ltd. Chichester (U.K.).

F. E. Albert Thumann, Handbook of Energy Audits, (1979), The Environment Press.

CLASS: M.E. CHEMICAL ENGINEERING — Semester – I

SUBJECT: Elective I

2. Chemical Process Synthesis

Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Synthesis of steady state flow sheet. Optimization of flow sheet with the respective heat-exchanger network. Optimization of steady state flow sheet with respect to adjustment of the concentration. Synthesis of process flow sheet. Safety in chemical plant designing. Trouble shooting hazard analysis. Fault diagnosis in chemical plant through data analysis and computation. Reliability consideration in maintenance policies of a chemical plant

Reference Books :

Anil kumar, Chemical process Synthesis and Engineering Design, (1981), Tata McGraw Hill.

CLASS: M.E. CHEMICAL ENGINEERING		Semester – I	
SUBJECT: Elective I 3. Petroleum Refining			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	**03**	**100**
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		**25**
	Seminar		**25**
	Total		150

Detailed Syllabus

Physical and Chemical operations to produce and products from crude oil, Blending of stocks to meet products specifications, Design of selected refinery units. Selection and conversion of petroleum feedstock's to chemicals, cracking oxidation, alkylation, dealkylation, isomerization and disproportionation processes, Basics and Design aspects, Economics considerations

Reference Books

W.L.Nelson, Petroleum Engineering, (1961), McGraw Hill.

R. J. Hengateback, Petroleum Refining (1959), Mc Graw Hill

V.Y. Stern, Gas Phase Oxidation, Petroleum Technology, 4th Edition, (1973), Applied Science, London.

L.F. Hatch and S. Matar, from Hydrocarbon to Petrochemicals (1981), Gulf Publishers, Houston.

CLASS: M.E. CHEMICAL ENGINEERING Semester – II

SUBJECT: Advanced Mass Transfer

Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	Theory Examination	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

1. Multicomponent Separations : General Short-cut Methods
2. Multicomponent Separations : Alternate short-cut method.
3. Multicomponent Separations : Rigorous methods for distillation
4. Multicomponent Separations : Rigorous methods for absorption.
5. Multicomponent Separations : Rigorous methods for extraction

Reference Books :

B.D. Smith, Design of Equilibrium Staged Processes, McGraw Hill.

Van Winkle , Distillation, McGraw Hill.

CLASS: M.E. CHEMICAL ENGINEERING		Semester – II	
SUBJECT: Advanced process Dynamics and Control			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Single Loop Control

Feedback control systems, Conventional feedback controller design, Design of more complex control structures, Controller design for processes with difficult dynamics, Control design for nonlinear systems, Model based control

Multivariable process Control

Introduction to multivariable systems, Interaction analysis and multiple single loop designs, Design of multivariable controllers

Computer process Control

Introduction to sample-data systems, Tools of discrete – time systems analysis, Dynamic analysis of discrete-time systems, Design of single controllers

Special Control Topics

Model predictive control, Statistical process control.

Reference Books :

W. Hermon Ray, B. Ogunnaike, process Dynamics, Modelling and control, (1984), Oxford University Press, London.

CLASS: M.E. CHEMICAL ENGINEERING		Semester – II	
SUBJECT: Advanced Computer Aided Design			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	**03**	**100**
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		**25**
	Seminar		**25**
	Total		**150**

Detailed Syllabus

Physical Properties of Liquid and Gases :

Introduction, Diffusion coefficients (Diffusivities), Compressibility, Z-factor of Natural Gases.

Equipment Sizing :

Introduction, Sizing of vertical and horizontal separators, Sizing of Partly filled Vessels and Tanks. Preliminary Vessel Design, Cyclone design, Gas dryer(dehydration) Design

Mass Transfer :

Multicomponent Distillation and Minimum Trays in Distillation Columns.

Engineering Economics :

Introduction, Capital Estimation

Reference Books :

A. Keyode Coker, Fortran Programs for Chemical Process Design, Analysis and Simulation, (1995), Gulf Publishing Co.

CLASS: M.E. CHEMICAL ENGINEERING		Semester – II	
SUBJECT: Elective II **1. Advanced Separation Techniques**			
Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	**03**	**100**
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		**25**
	Seminar		**25**
	Total		150

Detailed Syllabus

Solute Transport parameters for membrane performance prediction in RO/UF systems involving aqueous and non-aqueous solution. Physic-Chemical, polar, non-polar criteria governing RO separation, membrane transport mechanism. Membrane fouling and compaction. TFC membrane development RO/UF/ED process design module analysis. RO/UF/ED and DD in acid and enzyme recovery from scarified hydrolytes. Membrane technique in reclamation of water and chemical along with pollution control from industrial effluents. Cost benefit analysis and resources recycling and environmental quality improvement by MT. Industrial processing with membrane, membrane reactor concept in biotechnology concentration. Gas separation by RO.

Reference Books :

S. Sourirajan and T. Mataura, RO-UF : Principles and Applications (1986), NRCC publications, Ottawa, Canada.

Munir Cheryan, Uf Applications Handbook, (1986), Technic Publishing CO. Lancaster, USA.

CLASS: M.E. **CHEMICAL ENGINEERING** **Semester – II**

SUBJECT: Elective II

2. Polymerization Reaction Engineering

Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Classification of polymerization reactions, Chain chemical reactions and polyaddition, Reactor mechanisms and rate equations, order of polymerization reactions.

Molecular weight distribution in batch and continuous reactors, Average molecular weight and experimental determinations based on viscosity osmotic pressure etc., free radical polymerization, semi-batch reactor operation, design of batch and continuous reactors.

Heterogeneous, poly-addition reactions, suspensions and emulsion polymerization, Smith-Ewart's theory and Stockmayers equation, continuous emulsion polymerization, Anionic and Cationic polyaddition, Copolymerization, Mayo's equation and reactivity reaction, Alireg-price equation, Rate of copolymerization and Y factor, Skiest's Equation.

Polycondensation, reactions, Flory equations and molecular weight distributions.

Reference Books

Anil Kumar and Rakesh K. Gupta, Fundamentals of Polymerization,(1998), McGraw Hill.

Anil Kumar and s. . Gupta. Reaction Engineering of Step Growth Polymerization, (1989), Plennum Press, New York.

G. W. Billemeyer, Encyclopedia of Polymer Science and Technology, (1969), Interscience.

CLASS: M.E. CHEMICAL ENGINEERING Semester – II

SUBJECT: Elective II

3. Corossion in Industry and its Control.

Periods Per Week (Each of 60 min.)	Lectures	03	
	Practical	----------	
	Tutorial	---------	
		Hours	Marks
Evaluation System	**Theory Examination**	03	100
	Practical and Oral Examination	-----	----
	Oral Examination	-----	
	Term Work/ Assignments		25
	Seminar		25
	Total		150

Detailed Syllabus

Introduction:

The economic aspects of corrosion. Case studies. Some exampled of catastrophic corrosion filters. Corrosion inspections, instrumentation and monitoring. Principal engineering materials for equipment.

Corrosion of Stainless Steel :

Use of DSA in eiecirochemical industries, Corossion control using the exotic materials. Fabrication of special alloys, Stainless Steel, less common metals composite materials, Plastic etc.. welding techniques and corrosion behaviour of weld metals. Design the aspects to minimize the corrosion. Chemical cleaning of an equipment, Corrosion and Control methods for water supply systems, cooling systems, hot water systems, underground and marine environments. corrosion in nuclear reactors, and boilers. Corrosion in pipe lines, internal and external protection of pipe line. Corrosion of reinforcements in concrete structure.

Design of cathodic and anodic protection systems. Selection of the malerial for sacrificial anodes – anodes for impressed current methods of protection. Corrosion control in industrial environments

Electrochemical machining :

Temporary corrosion prevention methods and use of inhibitors industry.

Reference Books :

G. L. Shavartz and M.M.Kristal, Corrosion of chemical Apparatus, (1
Chepman Hall Ltd. London.

Semester III

Project-I

The Project work should be of Research nature only and it should be started during the third semester and the candidate must do the following:

1. Literature Survey
2. Problem Formulation

Around 35% of the Project work should be completed in this semester. The remaining 65% work will be carried out in the fourth semester. Each student is required to submit a detailed report about the work done on topic of the Project as per the guidelines decided by the University. The Project work is to be evaluated through Presentations and Viva-Voce during the semester and at the end of semester as per the guidelines decided by the University from time to time.

Seminar

The seminar work shall consist of study of a topic in the new areas and technical developments in the field of Chemical Engineering. A candidate is expected to select the topic in consultation with his guide.

The seminar report shall be a bound journal of about 50 pages, duly signed by the Guide and Head of the Department. Adequate number of copies of the seminar report will be submitted by the candidate.

The candidate will make a presentation of the seminar by way of lecture-cum-demonstration followed by question-answer session.

The seminar will be jointly assessed by a panel of internal (Guide) and external examiners.

Semester IV

Project-II

Around 35% of the Project work should be completed in third semester. The remaining 65% work will be carried out in this semester. Each student is required to submit a detailed Project report about the work done (III Sem + IV Sem) on topic of Project as per the guidelines decided by the University. The Project work is to be evaluated through Presentations and Viva-Voce during the semester and Final evaluation will be done at the end of semester as per the guidelines decided by the University from time to time. The candidate has to present/publish one paper in national/international conference/seminar/journal of repute is must before submission.