DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.ACAD/NP/M.E./Mech.,Chem.Engg./Syll./31/2013

It is hereby informed to all concerned that, on the recommendation of the Dean, Faculty of Engineering and Technology, the **Academic Council at its meeting held on 29-06-2013 has accepted the "Revised Syllabus of M.E. Mechanical" and "New Syllabus of M.E. Chemical Engineering" under "C.G.P.A." as per Appendix-"A" & "B" respectively under the Faculty of Engineering and Technology".**

This is effective from the **Academic Year 2013-2014** and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.ACAD/NP/ENGG./SYLLABUS/
2013/30292-300

Date:- 20-08-2013.

★
★
★
★
★
★
★
******

Director,
Board of College and University Development.

Copy forwarded with compliments to :-

1] The Principals, affiliated concerned Colleges,
Dr. Babasaheb Ambedkar Marathwada University.
2] The Director, University Network & Information Centre, UNIC, with **a request to upload the above syllabi on University Website [www.bamu.ac.in].**

Copy to :-

1] The Controller of Examinations,
2] The Superintendent, [Engineering Unit],
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The Superintendent, [Eligibility Unit] ,
6] The Director, [E-Suvidha Kendra], in-front of Registrar's Quarter,
Dr. Babasaheb Ambedkar Marathwada University,
7] The Record Keeper,
Dr. Babasaheb Ambedkar Marathwada University.

-=**=-

S/200813/-*

Dr. Babasaheb Ambedkar Marathwada University Aurangabad.

Faculty of Engineering & Technology

Rules and Regulations for M.E. & M.Tech. -2014

- **What is a credit system**

  A credit system is a systematic way of describing an educational program by attaching credits to its components. The definition of credits in higher education systems may be based on different parameters, such as student workload, learning outcomes and contact hours.

- **Advantages of the Credit System**
  - Represents a much-required shift in focus from teacher-centric to learner-centric education since the work load estimated is based on the investment of time in learning, not in teaching.
  - Helps to record course work and to document learner work load realistically since all activities are taken into account-not only the time learners spend in lectures or seminars but also the time they need for individual learning and the preparation of examinations etc.
  - Segments learning experience into calibrated units, which can be accumulated in order to gain and academic award.
  - Helps self-paced learning. Learners may undertake as many credits as they can cope with without having to repeat all the courses in a given semester if they fail in one or more courses. Alternatively, they can choose other courses and continue their studies.

- **What is Grading?**

  The word Grade derived from the Latin word gradus, meaning, step. Grading, in the educational context is a method of reporting the result of a learner's performance subsequent to his evaluation. It involves a set of alphabets which are clearly defined and designated and uniformly understood by all the stake holders. A properly introduced grading system not only provides for a comparison of the learner's performance but it

also indicate the quality of performance with respect to the amount of efforts put in and the amount of knowledge acquired at the end of the courses by the learners.

- **CURRICULUM:**

1.1 Curriculum:

Every program with specialization has a prescribed course structure which in general terms is known as Curriculum. It prescribes course to be studied in each semester; the relevant information containing course structure along with detail syllabus for each course of each program is updated periodically and is uploaded on the website.

1.2 Semesters:

The Faculty of Engineering & Technology implements a credit based curriculum and grade based evolution system for P.G. program is of four semesters. The academic courses are delivered in the first two semesters. Dissertation work is carried out by a student in the third and fourth semester. The first semester begins in the last week of July ends by the last week of November while the second semester begins in the first week of January and ends by the second week of May. Total duration for each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

1.3 Course Credit:

Education is organized around the semester-based credit system of study. The prominent features of the credit system are a process of continuous evaluation of a student's performance/progress and flexibility to allow a student to progress at an optimum pace suited to his/her ability or convenience, subject to fulfilling minimum requirements for continuation.

A student's performance/progress is measured by the number of credits that he/she has earned, i.e. completed satisfactorily. Based on the course credits and grades obtained by the student, grade point average is calculated. A minimum grade point average is required to be maintained for satisfactory progress and continuation in the program. Also a minimum number of earned credits and a minimum grade point average should be acquired in order to qualify for the degree. All programmes are defined by the total credit requirement and a pattern of credit distribution over courses of different categories.

1.4 Course credits assignment

Each courses, except a few special courses, has a certain number of credits assigned to it depending upon its lecture, tutorial and laboratory contact hours in a week. This weightage is also indicative of the academic expectation that includes in-class contact and self-study outside of class hours.

Lectures and Tutorials: One lecture or tutorial hour per week per semester is assigned one credit.

Seminar/Contact Hours per week per semester is assigned one credit

Practical/Laboratory: One laboratory hour per week per semester is assigned half credit.

Example: Course: XYZ Engg: 3 credits (3-1-2)

The credits indicated for this course are computed as follows:

3 hours/week lectures = 3 credits

1 hours/week tutorial = 1 credit

2 hours/week practical = 2 x 0.5 = 1 credit

2 hours/week seminar = 2 x 0.5 = 1 credit

Dissertation seminar/Contact Hours = 1 x 1= 1 credit

(3-1-2) 3 credit course = (**3** h Lectures + **1** h Tutorial + **2** h Practical/Dissertation seminar) per week i.e. 6 Contact hours per week

1.5 Earning Credits

At the end of every course, a letter grade is awarded in each course for which a student had registered. On obtaining a pass grade, the student accumulates the course credits as earned credits. A student's performance is measured by the number of credits that he/she has earned and by the weighted grade point average.

The credit system enables continuous evaluation of a student's performance, and allows the students to progress at an optimum pace suited to individual ability and convenience, subject to fulfilling minimum requirement for continuation.

1.6 Evaluation System

1. Semester Grade Point Average (SGPA) =

   SUM (course credits in passed courses X earned grade points)

   SUM (Course credits in registered courses)

2. Cumulative Grade Point Average (CGPA) =

   SUM (course credits in passed courses X earned grade points) of all Semester
   ---
   SUM (Course credits in registered courses) of all Semester

3. At the end of M.E & M. Tech Program, student will be placed in any one of the divisions as detailed below.(According to AICTE Handbooks 2013-2014)

   I[st] Division with distinction : CGPA $\geq$ 8.25 and above

   I[st] Division : CGPA $\geq$ 6.75 and < 8.25

   II[nd] Division : CGPA $\geq$ 6.75 and < 6.25

As per AICTE Handbook (2013-14), new gradation suggested as follows,

Table 1

Grade Point	Equivalent Range
6.25	55%
6.75	60%
7.25	65%
7.75	70%
8.25	75%

Conversion of CGPA to percentage marks for CGPA $\geq$ 5.0 can be obtained using equations.

Percentage marks = (CGPA X10) – 7.5

An example of these calculations is given below:

Typically one example for academic performance calculations of semester –I

Table 2

Course No. (1)	Course Credit (2)	Grade Awards (3)	Earned Credit (4)	Grade Points (5)	Points Secured (6)=(4) x (5)
Subject 1	4	B	4	6	24
Subject 2	4	C	4	5	20
Subject 3	4	O	4	10	40
Subject 4	4	A+	4	8	32
Subject 5	4	C	4	5	20
Lab-1	2	A+	2	9	18
Lab-2	1	A+	1	9	9
Seminar-I	1	A+	1	9	9
Total	24		24	61	172

1. Semester Grade Point Average (SGPA) = $\frac{(172)}{(24)} = 7.16$

2. Cumulative Grade Point Average (CGPA) =
   Cumulative points earned in all passed courses = 172 (past semester) + 172 (this sem.) = 344

   Cumulative earned credits = 24 (past semesters) +24 (this sem) = 48

   $\frac{\sum (172 + 172)}{\sum (24 + 24)} = 7.16$

➢ **System Evaluation Table**

Table 3

Grade	Grade Points	Marks Obtained (%)	Description Performance
		Regular Semester	
O	10	91-100	Outstanding
A++	09	86-90	Excellent
A+	08	76-85	Very Good
A	07	66-75	Good
B	06	56-65	Fair
C	05	46-55	Average
D	04	40-45	Poor
F	00	Below 40	Fail
EE			Incomplete
WW			Withdrawal
XX	--	--	Detained
ABSENT	--	--	Absent
PP	--	--	Passed (Audit Course)
NP	--	--	Not Passed (Audit Course)

➢ **Grade Awards:**

i) A ten point rating scale shall be used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master's Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-4.

Table 4: Ten point grades and grade description

Sr.No.	Equivalent Percentage	Grade Points	Grade	Grade Description
1	90.00 – 100	10	O	Outstanding
2	80.00 – 89.99	9	A++	Excellent
3	70.00 – 79.99	8	A+	Exceptional
4	60.00 – 69.99	7	A	Very Good
5	55.00 – 59.99	6	B+	Good
6	50.00 – 54.99	55	B	Fair
7	45.00 – 49.99	5	C+	Average
8	40.01 – 44.99	4.5	C	Below Average
9	40	4.00	D	Pass
10	<40	0.00	F	Fail

ii) Non appearance in any examination/assessment shall be treated as the student have secured zero mark in that subject examination/assessment.

iii) Minimum D grade (4.00 grade points) shall be the limit to clear/pass the course/subject. A student with F grade will be considered as 'failed' in the concerned course and he/she has to clear the course by reappearing in the next successive semester examinations.

iv) Every student shall be awarded Grade points out of maximum 10 points in each subject (based on 10 Point Scale). Based on the Grade points obtained in each subject, Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) shall be computed. Results will be announced at the end of each semester and cumulative Grade card with CGPA will be given on completion of the course.

Proposed Coding System of M.E/M.Tech Subjects

Six Digit Code for a subject (PG Course)

	Digits →	1 2 3	4	5 6
Sr. No.	**Branch** ↓	**Branch code**	**Year**	**Subject**
1	Electronics	MEX	PG I year – 6	**Semester –I/III**
2	Electronics & Communication	MEC	PG II Year - 7	1-20 Theory
3	Electronics & Telecom.	MET		21-30 Practical
4	Digital Communication	MDC		31 Dissertation-I
5	Embedded System	MES		41-49 Electives
6	Structure Engineering	MSE		**Semester –II/IV**
7	Environmental Engineering	MEV		51-70 Theory
8	Water Resource Engineering	MWR		71-80 Practical
9	Computer Engineering	MCE		81 Dissertation-II
10	Computer Network	MCN		91-99 Electives
11	Software Engineering	MSW		
12	Mechanical Engineering	MME		
13	Thermal Engineering	MTE		
14	CAD/CAM	MCC		
15	Manufacturing	MMF		
16	Heat Power	MHP		
17	Design Engineering	MDE		
18	Machine Design	MMD		
19	Automation	MEA		
20	Chemical Engineering	MCH		
21	Computer & IT	MCI		
22	Production Process	MMP		
23	M.Tech Computer Science	MTC		
24	M.Tech Food Processing	MTF		
25	M.Tech Mechanical	MTM		

Note: - Kindly, Allot Same Code for same Electives/ subjects for different branches to avoid repetitions of Question papers/settings/assessments.

DEGREE OF MASTER OF ENGINEERING/TECHNOLOGY
(Course with effective from academic year: 2013-2014)

I	1	The examination for the Degree of Master of Engineering & Technology will be held in four semesters, M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II, M.E. ./M.Tech Semester-III, and M.E./M.Tech. Semester-IV in case of full time course. And for part time additional semester V & VI
II	**Rules & Eligibility**	
	1	Rule for admission to P.G. Degree course in Engineering and Technology as per rules and regulation of AICTE/DTE & Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.
III	**Evaluation method**	
	1	Each theory course will be of 100 marks and be divided in to internal examination of 20 marks and semester examination of 80 marks (20+80=100 marks). Each practical course will be of 50/100 marks
	2	There shall be minimum two class tests within a semester. First based on 30% syllabus taught and second based on 30% syllabus taught. The setting of question paper and assessment will be done by the concerned teacher who has taught the syllabus. Average marks obtained out of two examinations will be considered for the preparation of final sectional marks/ grade.
	3	The Question papers in theory subjects shall be set by the Examiners appointed for the purpose by the University on the recommendations of the Board of studies of the concerned PG Course.
	4	The assessment of the Practical for any subject will be done by recognized post-graduate teacher appointed by University.
	5	To pass the examination a candidate must obtain a minimum CGPA of 6.25 (CGPA to the scale of 10).
	6	Candidate who secures CGPA $\geq$ 6.25 and CGPA < 6.75 declared to have passed examination in second class.
	7	Candidate who secures CGPA $\geq$ 6.75 and CGPA < 8.25 declared to have passed examination in first class.
	8	Candidate who secures CGPA $\geq$ 8.25 declared to have passed examination in

		first class with distinction.
IV	1	In case candidates fails to get less than D grade in one or more heads of passing examination, he will be allowed at his option, to reappear for only those heads of passing in which he has failed or got less than D grade at subsequent examinations.
	2	The grades obtained by the candidate in any head of passing at the examination will be carried forward unless the candidates reappear for the head of passing in accordance with ref. IV (1)
	3	In case the candidate passes in all heads of passing under M.E./M.Tech. Semester-I, M.E./M.Tech. Semester-II examination and obtained a minimum CGPA of 6.25 in M.E./M.Tech Semester-I, M.E./M.Tech Semester-II taken together as required under ref. II(2) above, he will not be allowed to reappear for any head of passing under M.E. Semester-I, M.E. Semester-II in accordance with ref. III(5)
	4	A candidate will not be allowed to appear for M.E. ./M.Tech Semester-III examination unless he passes in all heads of passing under M.E. ./M.Tech Semester-I, M.E./M.Tech Semester-II examination and obtains a minimum CGPA of 6.25.
	5	Whenever a candidate reappears for M.E. ./M.Tech Semester-III and M.E./M.Tech. Semester-IV examinations he will have to resubmit the dissertation with suitable modification and must also reappear for oral examination on it.
	6	A candidate registered for M.E./M.Tech Examination must clear his examination within five years from the date of registration.
V	**Attendance Requirement**	
	1	Each semester of the course shall be treated as a separate unit for calculation of the attendance
	2	A candidate shall be considered to have satisfied the attendance requirement if he/she has attended not less 75% of the class in each subject of all the semesters (Theory, Laboratory, Semester Practical training and Dissertation work) actually conducted up to the end of the semester.
	3	A Candidate, who does not satisfy the attendance required, mentioned as above, shall not be eligible to appear for the Examination of that semester and

		shall be required to repeat that semester along with regular students later.
	4	The Principal of the concerned College shall display regularly, the list of such candidates who fall short of attendance, on the Notice Boards.
	5	The list of the candidates falling short of attendance shall be sent to the University at least one week prior to the commencement of theory/practical examination, whichever is earlier.
VI	.	The following are the syllabi in the various subjects of the examination for the Degree of Master of Engineering/Technology.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD.

New Syllabus of

M.E.

(CHEMICAL ENGINEERING)

[Effective from the Academic Year 2013-14 & onwards]

Dr Babasaheb Ambedkar Marathwada University

Aurangabad
Program Structure for [ME in Chemical Engineering]
With Effect from 2013-2014

Subject Code	Semester - I Subjects	Contact Hrs/Week				Examination Scheme (Marks)						
		L	T	P/CH	Total	CT	TH	TW	Pr	Total	Duration of Theory Examination	Credit
MCH601	Advanced Mass Transfer	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH602	Process Modelling and Optimization	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH603	Advanced Chemical Engineering Thermodynamics	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH604	Pollution Control	3	1	-	4	20	80	-	-	100	3 hrs	4
*	Elective -I	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH621	Advanced Mass Transfer Lab-I	-	-	4	4	-	-	-	50	50	-	1
MCH622	Process Modelling and Optimization Lab-II	-	-	2	2	-	-	50	-	50	-	2
MCH623	Seminar-I	-	-	2	2	-	-	-	50	50	-	1
Total of Semester - I		**15**	**5**	**8**	**28**	**100**	**400**	**50**	**100**	**650**		**24**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact hours per week CT: Class Test

TH: University Theory Examination TW: Term Work Pr: Practical / Oral Examination

*** Elective I -**

MCH641 **Nanotechnology**

MCH642**Energy Audit and Conservation**

MCH643 **Petrochemical Technology**

Dr Babasahcb Ambedkar Marathwada University
Aurangabad
Program Structure for [ME in Chemical Engineering
With Effect from 2013-2014
Program Structure for [ME in Chemical Engineering]

Subject Code	Semester - II Subject	Contact Hrs/Week				Examination Scheme (Marks)						
		L	T	P/CH	Total	CT	TH	TW	Pr	Total	Duration of Theory Examination	Credit
MCH651	Advanced Chemical Reaction Engineering	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH652	Advanced Process Dynamics and Control	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH653	Advanced Transport Phenomena	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH654	Chemical Process Economics and Management	3	1	-	4	20	80	-	-	100	3 hrs	4
**	Elective -II	3	1	-	4	20	80	-	-	100	3 hrs	4
MCH671	Advanced Chemical Reaction Engineering Lab – I	-	-	4	4	-	-	-	50	50	-	1
MCH672	Advanced Process Dynamics and Control Lab – II	-	-	2	2	-	-	50	-	50		2
MCH673	Seminar-II	-	-	2	2	-	-	-	50	50	-	1
Total of Semester – II		**15**	**5**	**8**	**28**	**100**	**400**	**50**	**100**	**650**		**24**

L: Lecture hours per week T: Tutorial Hours per week P: Practical hours per week CH: Contact hours per week CT: Class Test

TH: University Theory Examination TW: Term Work Pr: Practical / Oral Examination

**** Elective II -**

MCH691 **Membrane Technology**

MCH692 **Statistical Design of Experiment**

MCH693 **Biomedical Engineering**

Dr Babasaheb Ambedkar Marathwada University
Aurangabad
Program Structure for [ME in Chemical Engineering
With Effect from 2013-2014

Program Structure for [ME in Chemical Engineering]

Subject Code	Semester - III Subject	Contact Hrs/Week				Examination Scheme (Marks)						
		L	T	CH	Total	CT	TH	TW	P	Total	Duration of Theory Examination	Credit
MCH731	Dissertation (Part-I)	-	-	12	12	-	-	50	50	100	-	12
Total of Semester - III		-	-	**12**	**12**	-	-	**50**	**50**	**100**	-	12

L: Lecture hours per week T: Tutorial Hours per week CH: Contact hours per week CT: Class Test

TH: University Theory Examination TW: Term Work P: Practical / Oral Examination

Program Structure for [ME in Chemical Engineering]

Subject Code	Semester - IV Subject	Contact Hrs/Week				Examination Scheme (Marks)						
		L	T	CH	Total	CT	TH	TW	P	Total	Duration of Theory Examination	Credit
MCH781	Dissertation (Part-II)	-	-	20	20	-	-	100	200	300	-	20
Total of Semester - IV		-	-	20	20	-	-	**100**	**200**	**300**	-	**20**
Total of Semester - I, II, III & IV		**30**	**10**	**48**	**88**	**200**	**800**	**300**	**400**	**1700**	-	**80**

L: Lecture hours per week T: Tutorial Hours per week CH: Contact Hours per Week CT: Class Test

TH: University Theory Examination TW: Term Work P: Practical / Oral Examination

Total Credits Allotted

SEM I + SEM II + SEM III + SEM IV

24 + 24 + 12 + 20 = 80

Total Contact Hours

SEM I + SEM II + SEM III + SEM IV

28 + 28 + 12 + 20 = 88

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH601	Advanced Mass Transfer	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Molecular Diffusion. Diffusivity of gases and liquids. Diffusion in steady laminar flow systems, Free and Forced convection, mass transfer.	06
II	Analogy between transfer processes. Concept of Eddy diffusivity. Diffusion with homogeneous and heterogeneous chemical reaction.	08
III	Analogies between heat, mass and momentum transfer. Interphase transfer.	06
IV	Different models. FilmTheory. Penetration Theory. Surface Renewal Theory etc.	06
V	Uses and characteristics of separation processes. Selection of separation processes.	06
VI	Various contacting devices. Transfer with chemical Reaction.	08

Reference Books:

1. Treybal R.E., Mass Transfer Operations, Mc Graw Hill, 1981
2. Sherwood T.K., Pigford, and C.R.Wilke, Mass Transfer, McGraw-Hill Kogukusha Ltd., 1975.
3. Cheremisioniff, N.P. (Edr.) , Hand Book of Heat and Mass Transfer - Vol.II. (Mass Transfer and Reactor Design), Gulf publishing Company, Houston, 1986.
4. Cussler, E.L., Diffusion: Mass Transfer in Fluid Systems, Cambridge University, 1997.
5. R. Taylor, R. Krishna, Multicomponent Mass Transfer, John Wiley, 1993

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH602	Process Modelling and Optimization	4
Teaching Scheme **Theory: 3 Hrs/ Week** **Tutorial: 1 Hr/Week**		**Exam Scheme** **Theory: 80 Marks** **Class Test: 20 Marks**

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction to modeling, a systematic approach to model building, classification of models. Conservation principles, thermodynamic principles of process systems.	04
II	Development of steady state and dynamic lumped and distributed parameter models based on first principles.	06
III	Modelling of reactors. The model equations. Examples of reactor models. Modelling of venture scrubber. Turbulant bed contactor. Fluidised beds. Slurry reactors, Trickle bed reactors, Bubble columns, stirred tank reactors, Packed column.	06
IV	Introduction to process engineering and optimization, formulation of various process optimization problems and their classification, basic concept of optimization, convex and concave function, necessary and sufficient conditions for stationary points, Optimization of one dimensional problems.	08
V	Unconstrained multi variable optimization, direct search methods, indirect first and second order methods, linear Programming and its application : Simplex and Big M & two phase methods.	08
VI	Constrained multi level optimization, necessary and sufficient conditions for optimum, quadratic programming, Dynamic programming, integer and mixed integer programming.	08

Reference Books:

1. A.Hussein, Chemical Process Simulation, Wiley Eastern, 1986.
2. S. Pushpavanam, Mathematical Methods in Chemical Engineering, Prentice Hall, 1998
3. K.M. Hangos, I.T. Cameron, Process Modelling and Model Analysis, Academic Press,2001.
4. M. M. Denn, Process Modelling, John Wiley, 1987.
5. Rutherford Aris, Mathematical Modeling, Vol.1, A Chemical Engineer's Perspective (Process Systems Engineering), Academic Press, 1999.
6. W.L. Luyben, Process Modelling, Simulation and Control for Chemical Engineers, McGraw Hill,1990.
7. T.F.Edgar and D.M Himmelblau, Optimization of Chemical Processes, McGraw Hill, 2001.
8. Rao S.S , Engineering Optimization, New Age, 2000.
9. Sharma J.K. ,Operations Research, Macmillan India Limited,2003.
10. M.E. Davis, Numerical Methods and Modeling for Chemical Engineers, John Wiley & Sons, 1984.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH603	Advanced Chemical Engineering Thermodynamics	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Review of I and II Laws of Thermodynamics, P–V–T Relations of Pure Fluids	04
II	Graphical,Tabular and Mathematical representaion; Generalized compressibility chart;	08
III	Generalized EOS; Thermodynamic Potentials; Maxwell Relations,	06
IV	Thermodynamic Property Relations, Thermodynamic properties of real gases, Multicomponent mixtures,	08
V	Properties of solutions, Phase Equilibrium (VLE, LLE, VLLE)	08
VI	Review of Thermochemistry; Chemical reaction equilibria.	06

Reference Books:

1. J.M. Smith. H.C.V. Ness and M.M. Abott, Introduction to Chemical Engineering Thermodynamics, McGraw Hill International edition (5th ed.),1996.
2. J.M.Prausnitz, Molecular Thermodynamics of Fluid-Phase Equilibria, Prentice Hall Inc, New Jersey, 1999.
3.H. B. Callen, Thermodynamics and an Introduction to Thermostatics, 2nd Edition, John Wiley and Sons, 1985.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH604	Pollution Control	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Pollution Prevention in industries: Environment friendly chemical processes Properties and fates of environmental contaminants; Regulations for clean environment and implications for industries; Improved manufacturing operations.	04
II	Life Cycle Assessment and Environmental Audit: Life cycle assessment and pollution prevention economics; Hazard and risk Analysis; Pollution prevention planning; Design for the environment.	08
III	Conservation of Materials and Energy: Water energy and reagent conservation; Residuals management; Economic Recovery and Recycling of Wastes; Case studies.	06
IV	Total Quality Environment Management and Ems 14000: Municipal pollution prevention Programmes; Environment Management System-14000; Systematic, Structured and Documented Response to Environmental Issues; Auditable and Time Targeted Environmental Improvement Programs	08
V	Hierarchy of Environment Management Practices: Waste-specific pollution prevention; waste pre-generation focus on minimization/recycling.	08
VI	Waste-specific pollution control treatment: pre - generation focus on disposal/recycling, Waste-specific; Post-release-to environment focus: recycling/remediation.	06

Reference Books:

1. P. Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill, 2000.
2. T.K. Roy (Editor), Chemical Technology for better Environment, Allied Publishers Ltd, 1998.
3. M.M. El Halwagy, Pollution Prevention through Process Integration : Systematic Design Tools, Academic Press, 1997.
4. P.T. Anastas, and J.C. Warner, Green Chemistry: Theory and Practice, Oxford University, 1998.
5. D.T. Allen and D.R. Shonnard, Green Engineering, Prentice Hall, 2002.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH641	Elective –I (Nanotechnology)	4
Teaching Scheme **Theory: 3 Hrs/ Week** **Tutorial: 1 Hr/Week**		**Exam Scheme** **Theory: 80 Marks** **Class Test: 20 Marks**

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction to Nanotechnology: History of nano-revolution, nano scale materials and their applications, Carbon nano tubes, organic and inorganic nano structures. Future of the nanotechnology.	06
II	Materials used in Nanotechnology: An overview of the physical (mechanical, electrical) and chemical properties of different classes of solid materials such as metals, semiconductors, insulators and polymers. Examples of size effects of properties observed in thin films, colloids and nanocrystals.	06
III	Conventional Fabrication Techniques: Topdown and bottom up process, techniques used in conventional microfabrication including thin film deposition (e.g. CVD, PVD, lithography, chemical etching and electrodeposition).	08
IV	Techniques: Analytical techniques such as Scanning Electron Microscopy (SEM), Electron and X-ray Diffraction, Ellipsometry, Photoelectron, Optical and Ion spectroscopy and Probe Microscopy. Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM)	08
V	Applications: Examples of applications in Micro and Nano technology including, Micro fluidics, Micro Electron Mechanical Systems (MEMS), membrane technology, and catyalyst and coatings.	08
VI	Risks Analysis: Potential risks, Risks to Environment, societal risks, lab safety guidelines for handling nano materials.	04

Reference Books:

1.Sulbha Kulkarni, Nanotechnology principles and practices, Capital Publishers, 2006
2.Manasi Karkare, Nanotechnology fundamentals and Applications, I.K. International Publishing House, 2008.
3.M. Wilson, K. K. G. Smith, M. Simmons and B, Raguse; Nanotechnology, Chapman & Hall/CRC press 2002.
4.M. Meyyappan; Carbon Nanotubes, Science and application; CRC Press, 2005.
5. Alexei Nabok; Organic and Inorganic Nanostructures; Publisher Artech House, London, 2005.
6. H. Watarai, N. Teramae and T Sawada; Interfacial Nanochemistry; Kluwer Academic/Plenum Press, 2005.
7. A.G. Brecket, A Handbook on Nanotechnology, Dominant Publishers and Distributers, 2008.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH642	Elective –I (Energy Audit and Conservation)	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction: Energy outlook in India and Global Energy outlook, Need for Energy Conservation in Process Industries.	04
II	Energy Audit: Characterizing Energy Use, Energy Audit Procedure, Factors to be considered during Energy Audit.	08
III	Energy Efficient Operations: Optimum performance of existing facilities, Facilities Improvement.	06
IV	Thermodynamics and Economics: Second law of thermodynamics revisited, Methodology of thermodynamic analysis, thermodynamic analysis of common unit operations.	08
V	Thermodynamics and Economics: Use of Thermodynamic analysis to improve energy efficiency, Systematic design methods.	06
VI	Guidelines and Recommendations for Energy Efficiency Guidelines and Recommendations for improving process operation.	08

Reference Books:

1. Albert Thumann, F., Handbook of Energy Audits, The Environment Press, 1979.
2. Kenny, W., Energy Conservation in the Process Industries, Academic Press Inc. (London) Ltd., 1984.
3. Boustead, N. and Hancock, G., Handbook of Industrial Energy Analysis, Ellis Horwood Ltd. Chichester, 1979.
4. Practical Technique for saving Energy in Chemical, Petroleum and Metal industries, Noyes Data Operations, 1977.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH643	Elective –I (Petrochemical Technology)	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Origin, formation, and composition of petroleum & natural gas. Reserves & deposits of the world and in India. Types of crude & Indian crude types. Introduction to petrochemicals & petrochemical industry in India. Basic raw material for petrochemical synthesis and their sources. Preparation of feedstock for petrochemical production, main building blocks of petrochemical industry.	06
II	Characteristics of petrochemical manufacture & techniques involved. Naphtha cracking, alkylation's, isomerisation and polymerization to produce petrochemicals. Petrochemicals and their applications. Classification of petrochemicals according to source : Ethylene derivatives, Propylene derivatives, Derivatives of C_4 hydrocarbons, Derivatives of higher paraffin's, Polymers of Olefins & Plastics, Petroleum aromatics. Economic aspects of petrochemical industry in India.	06
III	Chemicals from methanol & synthesis gas like formaldehyde, carbon-di-sulfide, hydrogen cyanide, etc. Chemicals from ethane, ethylene& acetylene like synthetic ethanol, glycols, acids, acetates, ketones, amines, etc. Chemicals from propane & propylene like isopropanol, acetone, glycerol, glycols, etc. Chemicals from butanes, pentanes like butadiene, butanol amines, butyl acetate, methyl ethyl ketone, etc.	08
IV	Chemicals from aromatics like mono-chloro & di-chloro benzene, BHC, nitrobenzene, nitrotoulene, pthalic anhydride, terepthalic acid & dimethyl teraphthalate, adipic acid, hexamethylene diamine, maleic anhydride, etc.	08
V	Polymers : Different types of polymerization techniques like bulk, emulsion, suspension, engineering and special types of polymers etc. At least two different types of polymeric products & their manufacture from each of the different types of polymerization techniques.	06
VI	Future of petrochemicals. Natural gas as a petrochemical feed stock, Integrated petrochemical complex, with power generation, pollution control – norms and methods of elimination, brief description on safety considerations. Energy crisis and petrochemical industry. Trends in petrochemical industry.	06

Reference Books:

1. W. L. Nelson, Petroleum Refinery Engineering, McGraw Hill Book Co, 1985.
2. N.K. Sinha, Petroleum Refining and Petrochemicals, Umesh Publications, Delhi, 2003.
3. R. F. Goldstein, The Petroleum Chemicals Industry, E & FN London, 1967.
4. W. S. Gruese and Dr. Stevens, Chemical Technology of Petroleum, McGraw Hill, 1960.
5. A. I. Waddams, Chemicals From Petroleum, Chemical Publishing Co, 1969.
6. W. F. Bland and R. L. Davidson, Petroleum Processing Hand Book, McGraw Hill, 1967.
7. A. Chauvee and G. Lefebure, Petroleum Processing Part-2, Gulf Publishing Company, 1986.
8. B. K. Bhaskara Rao, Modern Petroleum Refining Processes, Khanna Publishers, New Delhi,1997.
9. B. K. Bhaskara Rao, A Text on Petrochemicals, Khanna Publishers, New Delhi,1987.
10. M. Gopal Rao, M. Sittig, Dryden's Outlines of Chemical Technology, East-West Press Pvt. Ltd.,2010.
11. G.T. Austin, Shreve's chemical Process Industries, McGraw Hill Book Co., 1985.

Assessment:
Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH621	Advanced Mass Transfer Lab-I	1

Teaching Scheme	Exam Scheme
Practical: 4 Hrs/ Week	Practical/Oral: 50 Marks Term Work: --

List of Experiments: (Any eight of the following)

1. Mass transfer coefficient
2. Diffusion co-efficient of liquid
3. Tray dryer
4. Batch drying
5. HTU/NTU.
6. Humidification (Cooling tower)
7. Adsorption.
8. Ion exchange.
9. Dehumidification
10. Gas absorption with reaction.
11. Wetted wall column.
12. Fixed bed absorber
13. Vapor Liquid equilibria
14. Simulation of any mass transfer equipment
15. Flash/Equilibrium distillation
16. Batch distillation
17. Steam distillation
18. Tie line extraction
19. Kunni extraction column
20. Packed extraction column(Liquid –Liquid)
21. Spray extraction column
22. Solid-Liquid extraction
23. Ternary Phase Diagram
24. HETP
25. Packed Bed Distillation column
26. Batch crystallizer

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH622	Process Modelling and Optimization Lab-II	2

Teaching Scheme	Exam Scheme
Practical: 2 Hrs/ Week	Practical/Oral: -- Term Work: 50 Marks

List of Experiments / Assignments : (Any eight of the following)

Term work should consist of assignments on modelling of chemical process/equipment as case studies.

Detailed note on a topic or optimization methods where applicable on each of topics as per syllabus.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-I

Subject Code	Subject Name	Credits
MCH623	Seminar-I	1
Teaching Scheme **Practical: 2 Hrs/ Week**		**Exam Scheme** **Practical/Oral: 50 Marks** **Term Work: --**

Detailed Course Contents

A seminar topic on advanced studies of chemical process and plant design is allotted to individual student. The student is required to submit a detailed report and give oral presentation. Students also require reporting the related work at different stages. The overall assessment is converted to grade in this subject.

Student should deliver seminar on the state of the art topic in front of the external examiners and internal examiners, staff and student colleagues. Prior to presentation student should carry the details of literature survey from standard references such as international journals and periodicals, recently published reference books etc. Student should submit a report on same along with computer based presentation copy to the concerned examiner/guide at the end of seminar. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH651	Advanced Chemical Reaction Engineering	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	RTD for Chemical Reactors: General characteristics, Measurement of RTD characteristics, RTD in ideal Reactors, Zero Parameter Models, Segregation Model.	04
II	Analysis of Non-Ideal reactors: Basic Data, one parameter Models, The tank in the series Models, The dispersion model, two parameter model, Testing the model and determining its parameters, Other models of the non ideal reactors using the CSTR's and PFR's using the RTD	08
III	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	08
IV	External diffusion effects on the Heterogeneous Reactions: Binary diffusion, External resistance to Mass Transfer, The shrinking core model	06
V	Diffusion and Reaction in Porous Catalysts: Diffusion and Reactions in spherical catalyst 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 limiting situation from reaction data	08
VI	Design of Heterogeneous Catalytic Reactors: Isothermal and adiabatic fixed bed reactors, Non-Isothermal, Non-adiabatic fixed bed reactors, slurry reactors, trickle bed reactors	06

Reference Books:

1. H.Scott Foggler, Element of Chemical Reaction Engineering, Prentice Hall of India, 2005.
2. J.M.Smith, Chemical Engineering Kinetics, 3rd edition, McGraw Hill Publications, 1981.
3. J.Canberry, Chemical and Catalytic Reaction Engineering, McGraw Hill Publications, 1976.
4. O. Levenspiel, Chemical Reaction Engineering, 3rd edition, John Wiley & Sons, 2004.
5. Bischott K.B. and Forment G.F., Chemical Reactor Design & Analysis, John Wiley & Sons, 1990.
6. Fromment G.F. and Bischoff K.B., Chemical Reactor Analysis and Design, John Wiley, 2010.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH652	Advanced Process Dynamics and Control	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Feed Back Control systems: Concept of feedback control, block diagram development, closed loop transfer functions, closed loop transient response, closed loop stability, root locus diagram. Conventional Feed Back Controller design: Preliminary consideration, controller tuning without a model.	06
II	Design of more complex control structures: Process with significant disturbance, cascade control, feed forward control, feedback augmented feed forward control, ratio control, processes with multiple outputs controlled by a single input, Process with single output controlled with multiple input (Split range control, multiple input for improved dynamics), antireset windup.	06
III	Controller design for non linear systems:Nonlinear controller design philosophies, linearization and classical approach, adaptive control principles (Scheduled adaptive control, model reference adaptive control, self tuning adaptive control), variable transformations. Model based control: Solving the process control problem, model based approaches (Direct synthesis approach, optimization approach), controller design by direct synthesis, internal model control, generic model control, optimization approaches. Introduction to multivariable systems: Nature of multivariable systems, multivariable process model, multivariable transfer functions and open loop dynamic analysis.	08
IV	Interaction analysis and multiple single loop design: Preliminary considerations of interaction analysis and loop pairing, relative gain array, loop pairing using RGA, loop paring for nonlinear systems, loop pairing for non-square systems, controller design procedure. Design of multivariable controllers: Decoupling, feasibility of steady state de-coupler design, steady state decoupling by singular value decomposition. Introduction to Sampled Data Systems: sampling and conditioning of continuous signals, signal conditioning, continuous signal reconstruction, mathematical description of discrete – time system, theoretical modeling of discrete time systems.	08
V	Tools of discrete time system analysis: Basic concepts of z-transforms, Dynamic analysis of discrete time systems: Open loop responses, characteristics of open loop pulse transfer functions, block diagram analysis of sampled data systems, stability. Design of digital controllers: The digital controller and its design, discrete PID controller from the continuous domain, other digital controller based on continuous domain strategies, digital controllers based on discrete domain strategies.	06
VI	Model Predictive Control: General principles of model predictive control, Model algorithmic control, commercial model predictive control schemes, academic and other contributions, nonlinear model predictive control, closing remarks. Statistical Process Control: The CUSUM chart, serial correlation effects and standard process control, stochastic process control.	06

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH653	Advanced Transport Phenomena	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Viscosity & the mechanisms of momentum transport: Introduction of viscosity and mechanism of momentum transport. Newton's law of viscosity. Newtonian & non-Newtonian fluids. Pressure & temperature dependency of viscosity. Molecular theory of viscosity of gases & of liquids. Shell momentum balances and velocity distributions: Shell momentum balances & boundary conditions, flow of a falling film, flow through a circular tube and an annulus, flow of two adjacent immiscible fluids, creeping flow around a sphere. The equations of change for isothermal systems : The equation of (i) continuity, (ii) motion, (iii) mechanical energy, (iv) angular motion	08
II	Use of the equations of change to solve flow problems. Dimensional analysis of the equation of change. Velocity distributions: Time dependent flow of Newtonian fluids. Comparison of laminar & turbulent flows. Time smoothed equations of change for compressible fluids, time smoothed velocity profile near a wall. Empirical expressions for turbulent momentum flux, turbulent flow in ducts & jets. Interphase transport in isothermal systems: Friction factors for flow in tubes, around spheres, packed columns. Macroscopic balances for isothermal flow systems: The macroscopic mass, momentum, angular momentum, mechanical energy balance. Estimation of viscous loss. Use of the macroscopic balances for steady – state & unsteady – state problems.	06
III	Thermal conductivity and mechanism of energy transport: Fourier's law. Temperature & pressure dependence of heat conductivity. Thermal conductivity of – gases, liquids & solids. Effective thermal conductivity of composite solids. Convective transport of energy. Shell energy balances and temperature distributions in solids & laminar flow : Shell energy balances – boundary conditions. Heat conduction with heat sources like, electrical, nuclear, viscous, and chemical. Heat conduction through a composite wall, in a cooling fin.	06
IV	Temperature distributions: Unsteady heat conduction in solids. Steady heat conduction in laminar, incompressible flow. Boundary layer theory of non isothermal flow. Time smoothed equations for incompressible non isothermal flow. Time smoothed temperature profile near a wall. Empirical expressions for heat flux, temperature distribution for turbulent flow in tubes & jets. Fourier analysis of energy transport. Analogy of interphase transport with momentum transport.	06
V	Diffusivity and the mechanism of mass transport : Definitions of concentrations, velocities, mass flow. Fick's law. Temperature & pressure dependence of diffusivities. Diffusion in gases at low density, in binary liquids, & in colloidal suspensions. Mass & molar transport by convection. The Maxwell – Stefan equations. Concentration distribution in solids & in laminar flow: Shell mass balances. Boundary conditions, diffusion through a stagnant film, with a homogenous and a heterogeneous chemical reaction. Diffusion into a falling liquid film – gas absorption & solid distribution (diffusion &	06

Reference Books:

1. Babatunde A. Ogunnaike, and W. Harmon Ray, Process Dynamics, Modeling, and Control, Oxford University Press, 1994.
2. D.E. Seborg, T.F.Edgar, D.A. Millicamp, Process Dynamics and Control, John Wiley, 2010.
3. E.S..Savas, Computer Control of Industrial Processes, McGraw Hill,1965.
4. T.E. Marlin, Process Control - Designing Processes and Control Systems for Dynamic Performance, McGraw Hill, 2000.
5. P. Harriot, Process Control, McGraw Hill, 1984.
6. D.R. Coughnowr and Steven LeBlanc, Process Systems Analysis and Control, 2nd Edition, McGraw Hill International, 2011.
7. Stephanopoulos, G., Chemical Process Control - An Introduction To Theory And Practice, Prentice-Hall, 1984.
8. Smith, C. and A. Corripio, Principles And Practice Of Automatic Process Control, Wiley, 1985.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

	chemical reaction inside a porous catalyst).	
VI	Concentration distribution : Time dependent diffusion, steady – state transport in binary boundary layers. Steady – state boundary layer theory for flow around objects, concentration fluctuations & the time smoothed concentration. Time – smoothing of the equation of continuity. Semi – empirical expressions for the turbulent mass flux. Enhancement of mass transfer by a 1st order reaction. Analogy of interphase transport with momentum and energy transport.	08

Reference Books:

1. R.B. Bird, W.E. Stewart, E.N. Lightfoot, Transport Phenomena, John Wiley & Sons Inc., 2002.
2. W.M. Deen, Analysis of Transport Phenomena, Oxford University Press., 1998.
3. C.O. Benett, J.E. Mayers, Momentum, Heat and Mass Transport, McGraw Hill Publication, 1974.
4. William J. Thomson, Transport Phenomena, Pearson Education, Asia, 2001.
5. Christie J. Geankopolis, Transport Processes and Unit Operations, 4th Edition, Prentice Hall (India) Pvt. Ltd., New Delhi, 2004.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH654	Chemical Process Economics and Management	4
Teaching Scheme **Theory: 3 Hrs/ Week** **Tutorial: 1 Hr/Week**		**Exam Scheme** **Theory: 80 Marks** **Class Test: 20 Marks**

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction: General remarks on process plant design, Project, Demands on project engineers, Overview of activities.	06
II	Project Planning: Product development, Plant type: Location/kind of premises. Capacity/availability/lifespan, Degree of automation, Legal requirements, Costs, Investment, Operating costs. Inquiry/ Invitation to tender, Project controlling, Plant manufacturer: Risk analysis, Basic engineering, Process development, Balancing, Basic and process flow diagram, Materials concept, Main apparatus, Layout, Quotation, Quotation price, Contract negotiations.	06
III	Contract: Order basis, Regulations, Labour employment, Subcontractors, Project documentation, Technical part, Contractor's scope of supply and services, Employer's scope of supply and services, Commercial part: Deadlines/penalties, Warranties/penalties, Defects/acceptance, Prices/ terms of payment/bonds, Alterations/claims, Terminations/suspension, Insurance, Secrecy, Severability clause, Coming into effect, Signature policy.	08
IV	Project Management: Project Planning and Scheduling, Schematic Representation of Project Management, Pitfalls in Project Planning, Milestones and Milestone Planning, Work Breakdown Structure (WBS), Gantt Chart, Hierarchical Plan, Project Network, Activity Floats, Programme Evaluation & Review Technique (PERT), Critical Path, Project Control, Decision Making, Project Reporting, Project Meetings, Project Failure and Success.	08
V	How Public Investment in Projects is initiated in India? Steering Committee, Tender Committee, Joint Venture Organizations, Main Contributing Factors For Successful Projects, Management of Projects, Project Management Consultants (PMCs). Orientation, Indian Individuality, Organization Management Functions, Project Management Team, Desirable Characteristics, Competencies of Project Manager, Duties of a Project Manager, Project Team, Problem Areas of Concern.	06
VI	Project execution: Project organization: Project structures, Systematic, Project manual, Correspondence system, Revision service, Cost monitoring, Time scheduling/monitoring of dates, Computers in plant manufacturing. Approval planning, Component procurement, Piping and instrumentation diagrams, Electrical, Measurement and Control engineering, Layout and building design, Layout design, Building design, Piping planning, Documentation, Erection, Commissioning.	06

Reference Books:

1. Helmus, F., Process Plant Design – Project Management from Inquiry to Acceptance, Wiley-VCH Verlag GmBH & Co, 2008.
2. Thirumalai, R., Project Management in Emerging Environment of Globalization, Himalaya Publishing House, 1987.
3. Peters M. S. and Timmerhaus K. D., Plant Design and Economics for Chemical Engineers, McGraw Hill Inc., 2002.
4. J. Frank Valle-Riestra, Project Evaluation in the Chemical Process Industries, McGraw Hill Book Co., 1983.

Assessment:
Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH691	Elective –II (Membrane Technology)	4
Teaching Scheme Theory: 3 Hrs/ Week Tutorial: 1 Hr/Week		Exam Scheme Theory: 80 Marks Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Membrane transport and separation mechanism, Basic transport equations, solute transport parameters, surface force-pore flow model.	08
II	Prediction of membrane performance, physico-chemical criteria of membrane process, material science of RO/UF membranes.	06
III	Aqueous & non-aqueous solution systems, module design and analysis, membrane process design and systems,	06
IV	Membrane process in water, waste water, biotechnology process, food industries etc.	04
V	Membrane bioreactor, pervaporation techniques in alcohol concentration, gas separation application, by permeation under pressure through membrane	08
VI	Membrane fouling and compaction, liquid membranes, pollution control by membrane process. RO treatment of non-aqueous solutions in liquid phase.	08

Reference Books:

1. S.Sourirajan, and R.Malaura, RO/UF Principles and Applications, NRCC Publications, 1986.
2. Munir Cheryon, UF Applications Handbook, Technic Publishing Company, 1986.
3. K. Nath, Membrane Separation Process, Prentice Hall India, 2008
4. J.Wakeman, Filtration and Separation, Elsevier, 1986.
5. R. W., Rousseau, Handbook of Separation Process Technology, John Wiley & Sons, 1987.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH692	Elective –II (Statistical Design of Experiment)	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction to Statistics for Engineers: Simplest discrete and continuous distributions, Statistical inference, Statistical estimation, tests and estimates on statistical variance, Analysis of variance, Regression analysis (Simple linear, multiple, polynomial, nonlinear), Correlation analysis (Correlation in linear regression, correlation in multiple linear regression).	08
II	Design and Analysis of Experiments: Introduction to design of experiments, Preliminary examination of subject of research, Screening experiments.	04
III	Basic Experiment-Mathematical Modeling: Full factorial experiments and fractional factorial experiments, Second-order rotatable design (Box-Wilson design), Orthogonal second order design (Box Benken design), D-optimality, B -designs and Hartleys second order design.	08
IV	Statistical Analysis: Determination of experimental error, Significance of the regression coefficients, Lack of fit of regression models.	06
V	Experimental Optimization Of Research Subject: Problem of optimization, Gradient optimization method, Nongradient method of optimization, simplex sum rotatble design Canonical Analysis Of Response Surface.	06
VI	Mixture Design 'Composition-Property': Screening design 'composition-property', Simplex lattice design, Scheffe simplex lattice design, Simplex centroid design, Extreme vertices design, D-optimal design, Draper-Lawrence design, Factorial experiments with mixture, Full factorial combined with mixture design.	08

Reference Books:

1. Z.R.Lazic, Design of experiments in chemical engineering: A practical guide, Wiley, 2005
2. Antony J., Design of Experiments for Engineers and Scientists, Butterworth Heinemann, 2004.
3. Montgomery D. C., Design and Analysis of Experiments, 5th Edition, Wiley, 2010.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH693	Elective –II (Biomedical Engineering)	4

Teaching Scheme	Exam Scheme
Theory: 3 Hrs/ Week	Theory: 80 Marks
Tutorial: 1 Hr/Week	Class Test: 20 Marks

Unit No.	Detailed Course Contents	No. of Lectures
I	Introduction to physiology: Cell and its function, Nervous system, cardio vascular system, Respiratory system, Renal physiology, Basis of biopotentials, Prinicples of ECG, EEG, EMG.	04
II	Therapeutic procedures and medical instrumentation: Biochemicals, Biodynamic models and its application, cardiac assist devices, Biomechanics of head injury, Amplifier constraints and specification, Recording systems, Electrical grounding and patient safety, Transducers, Electrodes for recording biopotentials.	08
III	Bioelectrical signals and physiological control systems: Data acquisition, Extraction of signals from noise, Pattern recorgnition, Regulation of body temperature, Regulation and control in the CV system, Rheology of blood, Radiation dosimetry, Neuton activation analysis, Safety procedures for radiation diagnostics, Ultra sound effects.	08
IV	Biopolymers and transport phenomena in human biology: Introduction to biopolyments, Nature and composition of polymers used as prosthetic devices with special reference to heart valoes, Artifical bones, Denatures, Authres etc., Penal and respiratory system, Lung Oxygenator and their design characteristics, Artifical kidney and their design features.	08
V	Medical enzymology: Role of enzymes in clinical tests, as therepeutic agents, Role of enzyme electrodes in chemical testing, Extra corporeal shunts using immobilized enzymes.	06
VI	Biomedical ethics: Biomedical ethics for engineers, Risks, Environmental impacts, Bioethical research and technology development, bioethical success and failure, Sustainable bioethics.	06

Reference Books:

1. Brown, E., Biomedical Engineering , Davis, Philadelphia, USA, 1971.
2. Kennedy, K., Advances in Biomedical Engineering , Academic Press, 1970.
3. Vallero, D., Biomedical Ethics for Engineers, Academic Press,2007.

Assessment:

Section A: Unit 1, 2, 3
Section B: Unit 4, 5, 6
PATTERN OF QUESTION PAPER
Six units in the syllabus shall be divided into equal parts i.e. three units in each part. Question paper shall be set having two sections A and B, as per weight age of units. Section A question shall be set on first part and section B on second part. Question paper should cover entire syllabus.
For 80 Marks papers:
1) Section A & Section B should be of 40 marks each.
2) Five questions in each section.
3) Out of five four questions asked should be of 15 Marks & one question asked should be 10 Marks.
4) 10 marks question will be compulsory.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH671	Advanced Chemical Reaction Engineering Lab - I	1

Teaching Scheme	Exam Scheme
Practical: 4 Hrs/ Week	Practical/Oral: 50 Marks Term Work: --

List of Experiments: (Any eight of the following)

1. Interpretation of batch reactor data.
2. To study the kinetics of liquid phase irreversible reaction in a batch reactor.
3. To study the kinetics of liquid phase reversible reaction in batch reactor.
4. Conversation in CSTR.
5. Conversation in PFR.
6. Conversion in multiple reactors: CSTR followed by PFR.
7. Conversion in multiple reactors: PFR followed by CSTR
8. Effect of mixing in a Batch reactor
9. To carry out second order reaction in CSTR and to find the valve of rate constant.
10. To determine the pseudo first order rate constant.
11. To study the kinetics of liquid phase reaction by dilatometer
12. The kinetics of liquid phase reversible reaction with homogenous catalyst in a batch reactor.
13. The temperature dependency of liquid phase irreversible reaction.
14. Mass transfer with chemical reaction.
15. RTD in CSTR.
16. RTD in PFR.
17. RTD in packed bed reactor.
18. Characterization of catalysts.
19. CSTRs in series.
20. Heterogeneous catalytic reaction.
21. Catalyst Preparation
22. Neutralization Reaction

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH672	Advanced Process Dynamics and Control Lab - II	2

Teaching Scheme	Exam Scheme
Practical: 2 Hrs/ Week	Practical/Oral: --
	Term Work: 50 Marks

List of Experiments / Assignments : (Any eight of the following)

Term work should consist of assignments on chemical process dynamics and control as case studies.

Detailed note on a topic/where applicable on each of topics as per syllabus.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-II

Subject Code	Subject Name	Credits
MCH673	Seminar-II	1
Teaching Scheme **Practical: 2 Hrs/ Week**		**Exam Scheme** **Practical/Oral: 50 Marks** **Term Work: --**

Detailed Course Contents

A seminar topic on advanced studies of chemical process and plant design is allotted to individual student. The student is required to submit a detailed report and give oral presentation. Students also require reporting the related work at different stages. The overall assessment is converted to grade in this subject.

Student should deliver seminar on the state of the art topic in front of the external examiners and internal examiners, staff and student colleagues. Prior to presentation student should carry the details of literature survey from standard references such as international journals and periodicals, recently published reference books etc. Student should submit a report on same along with computer based presentation copy to the concerned examiner/guide at the end of seminar. The assessment shall be based on selection of topic its relevance to present context, report documentation and presentation skills.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-III

Subject Code	Subject Name	Credits
MCH731	Dissertation Part-I	12
Teaching Scheme Contact hours: 12 Hrs/ Week		Exam Scheme Practical/Oral: 50 Marks Term Work: 50 Marks

Detailed Course Contents

The Major Project Part-I is aimed at training the students to analyze independently any problem in the field of Chemical Process and Plant Design. The project may be analytical or computational or experimental or combination of all of them based on the latest developments in the said area. At the end of the semester, the students will be required to submit detailed report. The Major Project Part-I should consists of objectives of study, scope of work, critical literature review of the Major Project and preliminary work pertaining to the said work.

The dissertation Seminar will consist of a type written report covering the topic selected for Final Dissertation. This should include the literature survey, technical details and related data required for the proposed dissertation work. The candidate shall deliver the dissertation seminar on the topic which will be judged by two examiners (one external and one internal guide). The assessment shall be based on selection of topic, its relevance to present context, report documentation and presentation skills, utility of the dissertation work & publications based on the same.

Dr Babasaheb Ambedkar Marathwada University
Faculty of Engineering and Technology
Syllabus for M.E. (Chemical) Engineering
With Effect from 2013-2014
Semester-IV

Subject Code	Subject Name	Credits
MCH781	Dissertation Part-II	20
Teaching Scheme **Contact hours: 20 Hrs/ Week**		**Exam Scheme** **Practical/Oral: 200 Marks** **Term Work: 100 Marks**

Detailed Course Contents

Major Project Part-II is a continuation of the work done by the student during semester III. The student is required to submit thesis as a partial fulfillment of the M. E. degree. The thesis should consist of detailed study of the problem undertaken, concluding remarks and scope of future work, if any. The project report (thesis/Dissertation) is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical, computational and experimental aptitude of the student.

The student shall be allowed to submit the dissertation- II report only after the completion of dissertation- I. Student should deliver Viva-Voce Presentation on topic of Dissertation-II in front of the external examiners and internal examiners, staff and student colleagues The assessment shall be based on design and implementation aspects, report documentation and presentation skills, utility of the dissertation work & publications based on the same.