Dr. Babasaheb Ambedkar Marathwada University

(NAAC Reaccredited 'A' Grade)

Aurangabad 431004, Maharashtra, India

Department of Nanotechnology

Structure and Curriculum

for

M. Sc. Nanotechnology

(Choice Based Credit System)

(Academic Autonomy)

(Effective from June 2016 onwards)

Syllabus for M. Sc. (Nanotechnology) Academic Autonomy
(Choice Based Credit System)

The M.Sc. (Nanotechnology) programme is divided into four semesters having 123 credits. There are 20 theory courses subdivided into 12 core courses, 4 specialized courses and 4 elective course. Besides there are 4 laboratory courses, 4 seminar/assignment/tutorial courses and two semester project course including fundamentals of research and research project.

Eligibility:

0.848 : A candidate shall be admitted to the first year course for the master degree in the faculty of science provided that he has passed B.Sc. (any science stream with mathematics as one of the subjects at least till H.S.C. i.e. 12^{th}) , or any bachelors degree e.g. Medical, B. Tech., B. Pharm., or B.E. degree stream examination of this university or any other university recognized as equivalent.

0.849 : The degree of Master of Science shall be conferred on a candidate who has pursued a regular course of study consisting of two years and has appeared and passed the examination prescribed for the master's degree course in the faculty.

0.850 : A candidate who has passed the M.Sc. examination of this university recognized as equivalent there to may there to may also be permitted to take up course for M.Sc. degree in Nanotechnology, provided that he fulfill the condition laid down in 0.848 and 0.849.

0.851 : A candidate who has passed the M.Sc. examination of this university may be allowed to appear at the said examination again with the same subject to improve his performance (percentage of mark) provided that he appear at both the examination at a time on the basis of which the result is declared. Provided further that only one chance will be given to improve his qualification.

0.852 : A candidate who has passed the M.Sc. examination of any other statutory university may be allowed to appear at the said examination again with the same subject t improve his performance (percentage of mark) provided that he appear at both the examination at a time on the basis of which the result is declared. Provided further that he has been serving in any of the educational institution in this university area for at least a period of two years, provided further that only one chance will be given to improve his qualification.

0.853 : In case of a candidate who reappears for the M.Sc. examination as provided in 0.851 or 0.852 fails to improve his qualification, his performance at such reappearance shall be ignored.

0.854 : A candidate's choice of subject for the M.Sc. course examination shall be restricted to the subject offered at the time of degree examination.

Provided that a candidate who has passed the bachelor's degree examination.

i) Candidate with bachelor's degree in any of science , engineering technology or pharmacy shall be held eligible for admission to the M.Sc. in Nanotechnology and specialization emerging hereafter.
ii) With mathematics as one of the subject at least till H.S.C. i.e. 12^{th} standard shall be held eligible for admission to M.Sc. in Nanotechnology.
iii) With B.Sc./ B.E./ B.Tech./ B.Pharm./ degree examination of this university or any other university as equivalent there to with minimum 50% marks (45% for reserved category) shall be eligible for admission to M.Sc. Nanotechnology. However, National eligibility test qualified candidates for M.Sc. and meritorious candidates would be given preference at the time of admission. Provided further that if the marks secured by the candidate at the bachelor's degree examination in the subject (s) of eligibility are equal, preference shall be given to that candidate who has offered the same optional at the bachelor's degree examination in which he is seeking admission at M.Sc.

0.855 : A candidate who has passed the bachelor's degree in the faculty of science , Engineering, Pharmacy

or Technology subjects may be allowed to seek admission to the M.Sc. (Nanotechnology) course provided that he fulfill other conditions laid down in 0.848.

R.1773 : Nanotechnology being a fusion science , the subjects or sections within the subjects but not limited to the following list might be the part of the course work study for the M.Sc. examination.

23. Physics
24. Chemistry
25. Biochemistry
26. Zoology
27. Botany
28. Modern Biology
29. Microbiology
30. Mathematics
31. Statistics
32. Biophysics
33. Applied Mathematics
34. Material Science
35. Geology
36. Modern industrial electronics and microwaves
37. Electronics
38. Environmental Science
39. Industrial Chemistry
40. Biotechnology
41. Computer Science
42. All streams of engineering
43. All streams of technology
44. All streams / specialization in Medical and Pharmacy etc.

R.1774 : There shall be a university examination at the end of each semester in the subjects (s) for which the candidates has registered and applied for the M.Sc. examination.

R.1775 : The following shall be the scheme of the examination for each year.

R.1776 : These shall be 4 period per paper/ per practical/ per week duration of each period shall be of 50 minutes.

R.1777A : A candidate who fails in not more than 50% of papers/ practical at the first year examination shall be allowed to keep terms for second year. Any fraction, while calculating 50% of the papers/ practical shall be ignored.

Standard of Passing and Award of Division

R.1778: The minimum mark of passing in each paper/ practical shall be 40% of the maximum marks prescribed for the paper / practical.

R.1779: A candidate who secure 40% or more but less than 50% of the aggregate marks prescribed for I and II year taken together shall be awarded a Pass Division.

R.1780: A candidate who secures 50% or more but less than 60% of the aggregate marks prescribed for I and II year taken together shall be awarded a Second Division.

R.1781: A candidate who secure 60% or more of aggregate marks prescribed for I and II year taken together shall be awarded a First Division.

Admission / Promotion Process:

In response to the advertisement for registration, interested students will have to register themselves. Admission will be done on the basis of performance of students at their qualifying graduate level examination. Once the student is admitted he / she will be promoted to the next semester with full carryon, however students have to register themselves for every consecutive semester. Dropout students will be allowed to register for respective semester as and when the concerned courses are offered by the department, however he / she should not exceed more than twice the duration of the course from the date of first registration at parent department. The admission of the concern student will be automatically cancelled if he /she fails to complete the course within a period of maximum four years/ eight semesters.

Choice Based Credit System (CBCS) :

The choice based credit system has been adopted by this department. This provides flexibility to make the system more responsive to the changing needs of our students, the professionals and the society. It gives greater freedom to students to determine their own pace of study. The credit based system also facilitates the transfer of credits.

- Students will have to earn 100 credits for the award of M.Sc. degree.
- Out of 100 credits, students will have to earn 96 credits from within the departmental courses.
- Remaining 04 credits can be earned through opting service course from the other departments of the University (Subject to approval by the Departmental Committee of Nanotechnology Department). If the course opted by the students from other department is having less / more than 4 credits, it will be converted into 4 equivalent credits.

Credit-to- contact hour Mapping:

One contact hour per week is assigned 1 credit for theory and 0.5 credits for practical / laboratory course. Thus a 4 - credit theory course corresponds to 4 contact hours per week and same analogy will be applicable for practical / laboratory course.

Course Structure:

First Year Course:

Semester I (Core Courses)

Course	Course Title	Teaching Hours/week	Max Marks	Credits
NANO 111	Quantum Physics- I	4 Hours	100	4
NANO 112	Solid State- I	4 Hours	100	4
NANO 113	Chemistry- I	4 Hours	100	4
NANO 114	Bioscience- I	4 Hours	100	4
NANO 115	Research Methodology	1 hours	30	1
COM-100	*Constitution of India*	*2 hours*	*50*	*2*
NANO 116	Practical I	4 Hours	100	4
NANO 117	Seminar-I Fundamental Topics in Nanotechnology	4 Hours	100	4

Total Credits for Semester I : 27 (Theory : 19 ; Laboratory : 04, Seminar:04)

Semester II (Foundation Courses)

Course	Course Title	Teaching Hours/week	Max Marks	Credits
NANO 222	Quantum Physics- II	4 Hours	100	4
NANO 223	Solid State- II	4 Hours	100	4
NANO 224	Chemistry- II	4 Hours	100	4
NANO 225	Biosciences- II	4 Hours	100	4
NANO 226	Practical- II	4 Hours	100	4
NANO 227	Seminar-II Fundamental Topics in Nanotechnology	4 Hours	100	4

Total Credits for Semester II : 24 (Theory : 16 ; Laboratory : 04 ; Seminar : 04)

Second Year Course:

Semester III (Foundation Courses and Generic Elective Courses)

Course	Course Title	Teaching Hours/ week	Max Marks	Credits
NANO 333	Quantum Confinement I	4 Hours	100	4
NANO 334	Advances in Nanotechnology-I	4 Hours	100	4
NANO 335	Applications of Nanotechnology-I	4 Hours	100	4
NANO 336	Elective- A	4 Hours	100	4
NANO 337	Elective- B	4 Hours	100	4
NANO 338	Practical III	6 Hours	100	4
NANO 339	Project I	6 Hours	100	4
NANO 340	Seminar-III Advanced Topics in Nanotechnology	4 Hours	100	4
NANO 341	Compulsory Service Course from Other Department	4 Hours	100	4

Total Credits for Semester III : 36 (Theory :20 ; Laboratory :04 ; Project& Seminar: 08, S. Course: 04)

Semester IV (Generic and Open Elective Courses)

Course	Course Title	Teaching Hours/week	Max Marks	Credits
NANO 444	**Quantum Confinement II**	**4 Hours**	**100**	**4**
NANO 445	**Advances in Nanotechnology-II**	**4 Hours**	**100**	**4**
NANO 446	**Applications of Nanotechnology-II**	**4 Hours**	**100**	**4**
NANO 447	**Elective- C**	**4 Hours**	**100**	**4**
NANO 448	**Elective- D**	**4 Hours**	**100**	**4**
NANO 449	**Practical IV**	**6 Hours**	**100**	**4**
NANO 450	**Project II**	**6 Hours**	**100**	**4**
NANO 451	**Seminar-IV Advanced Topics in Nanotechnology**	**4 Hours**	**100**	**4**
NANO 452	**Compulsory Service Course from Other Department**	**4 Hours**	**100**	**4**

Total Credits for Semester IV:36 (Theory:20 , Laboratory : 04, Project & Seminar : 08, S. Cource:04)

[Total Credits : 123 (Sem. I : 27 + Sem. II : 24 : Sem. III : 36 + Sem. IV : 36)]

Nanotechnology Service Course for Other Departments Only

Following courses will be offered to other departments as service courses (subject to approval by the Departmental Committee). The time table for the service course will be arranged on Friday and Saturday (every week).

Course	Course Title	Teaching Hours/week	Max Marks	Credits
NANO 453	**Service Course (Fundamentals of Nanotechnology and its General Applications)**	**4 Hours**	**100**	**4**

Notes: (1) Tutorials consists of conceptual as well as numerical problems / questions based on the respective theory courses in the semester covering all five (05) units. Total marks assigned for tutorials will be 80 (20 for each theory course). Remaining 20 marks are assigned for seminar based on laboratory course.

(2) Each course / paper should be taught for 40 to 45 contact hours.

(3) Teaching duration for LAB COURSES in first and second semesters should be of 4 hours and for those in third and fourth semesters and project should be 06 hours per week per batch

(4) Each of the courses is divided into five units.

(5) The content of theory course / paper as well laboratory (practical) course may be modified time to time (with the approval DC) to keep pace with the recent developments and trends in the subject.

List of Generic Elective Courses for Semester III			
Sr. No.	Code	Name of Course	Semester
1		A: Nanomedicine (Drug Delivery) B : Modern Methods of Instrumental Analysis	III
List of Generic Elective Courses for Semester IV			
1		C : Material Sciences and technology D : Nanobiotechnology	IV

Attendance:

Students must have 75 % of attendance in each core, specialized, elective and laboratory course for appearing examination otherwise he / she will not be strictly allowed for appearing the examination of each course. However, students having 65 % attendance with medical certificate may request Head of the Department for the condo-nation of attendance. Monthly attendance of the students for each course will be displayed on the notice board.

Registration for Service Course:

- Students will have to register themselves for the service course of his / her interest after the start of semester in the department on official registration form. The teacher in-charge of the respective course will keep the record of the students registered. Maximum fifteen days period will be given from the date of admission for completion of registration procedure. The departmental committee shall follow a selection procedure after counseling to the students to avoid the overcrowding to a particular course at the expense of some other courses.
- No student shall be permitted to opt more than one service course in a semester.
- Normally no service course shall be offered unless a minimum of 10 students are registered.
- Students will have to pay the prescribed fees per course per semester /year for the registration as decided by the university.

Departmental Committee:

The existing Departmental Committee (DC) will monitor the smooth functioning of M. Sc. programme.

Results Grievances / Redressal Committee

Grievances / redressal committee will be constituted in the department to solve all grievances relating to the evaluation. The committee shall consist of Head/Co-ordinator of the Department and the concerned teacher of a particular course.

Evaluation Methods:

- The **grades for courses will be based on 20: 80 ratio** of continuous internal assessment (CIA) and semester end examination (SEE).

Internal Evaluation Method:

- There will be two mid semester examinations (20 marks each) as a part of continuous internal assessment (CIA), first based on 40 percent of the syllabus taught and second based on 60 percent of the syllabus taught. The setting of the question paper and the assessment will be done by the concerned teacher who has taught the course**. Average score obtained out of two mid semester examinations will be considered for the preparation of final sessional marks / grades**.

Term end Examination and Evaluation:

- Semester end examination (SEE) time table will be declared by the departmental committee and accordingly the concern course teacher will have to set question paper, conduct theory examination, conduct practical examination with external expert, evaluate, satisfy the objection /query of the students (if any) and submit the result to DC in one week time from the date of examination of that particular course / paper.
- The semester end theory examination in each theory course /paper will be of 80 marks. The total marks shall be 100 for each theory course / paper (80 marks semester end exam + 20 marks internal tests) and this is equivalent to 4 credits.
- Pattern of semester end question paper will be as below:
    - The semester end examination of theory course / paper will have two parts (20+60 = 80 Marks)
    - Part A will carry short questions of 2-3 marks (fill in the blanks/ answer in sentence / multiple choice questions) as compulsory question and it should cover entire syllabus (20 Marks)
    - Part B will carry 7 questions (12 marks each) out of which there shall be at least one question from each unit. Students will have to attempt any five questions (60 Marks).
    - 20 to 30% weightage can be given to problems wherein use of non-programmable scientific calculator may be allowed.
    - Number of sub questions (with allotment of marks) in a question may be decided by the examiner.

- Semester end practical examination will be of 50 marks each (semester end examination only). Student must perform at least eight experiments from each lab course. The final practical / project examination will be conducted at the end of each semester along with the theory examination. Students will be examined by one external and one internal examiner.

- At the end of each semester the Departmental Committee will assign grades to the students. The result sheet will be prepared in duplicate.

- Every student shall have the right to scrutinize answer scripts of mid semester /semester end examinations and seek clarifications from the teacher regarding evaluation of the scripts immediately thereafter or within 3 days of receiving the evaluated scripts.

- The Head of the Department shall display the grade points and grades for the notice of the students.

- The Head of the Department shall send all records of evaluation for safekeeping to the Controller of Examination in two week time after declaration of results.

Earning Credits:

At the end of every semester, a letter grade will be awarded in each course for which a student had registered. A student's performance will be measured by the number of credits that he/she earned by the weighted Grade Point Average (GPA). The SGPA (Semester Grade Point Average) will be awarded after completion of respective semester and the CGPA (Cumulative Grade Point Average) will be awarded at the end of the 4^{th} semester.

Grading System:

- The grading reflects a student-own proficiency in the course. A ten point rating scale shall be used for the evaluation of the performance of the students to provide letter grade for each course and overall grade for the Master Programme. Grade points are based on the total number of marks obtained by him / her in all heads of the examination of the course. The grade points and their equivalent range of marks are shown in Table-I

Table – I : Ten point grade and grade description

Sr No	Marks Obtained (%)	Grade Point	Grade	Description
1	90-100	9.00- 10	O	Outstanding
2	80-89	8.00-8.90	A^{++}	Excellent
3	70-79	7.00-7.90	A^{+}	Exceptional
4	60-69	6.00-6.90	A	Very Good
5	55-59	5.50-5.90	B^{+}	Good
6	50-54	5.00-5.40	B	Fair
7	45-49	4.50-4.90	C^{+}	Average
8	41-44	4.1-4.40	C	Below Average
9	40	4.0	D	Pass
10	< 40	0.0	F	Fail (Unsatisfactory

- Non appearance in any examination / assessment shall be treated as the students have secured zero marks in that subject examination / assessment.
- 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 appearing in the next successive semester examinations. There will be no revaluation or recounting under this system.
- 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 CGPA will be given on the completion of M. Sc. programme.

Computation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average)

Grade in each subject / course will be calculated based on the summation of marks obtained in internal and semester end examination.

The computation of SGPA and CGPA will be as below

- Semester Grade Point Average (SGPA) is the weighted average points obtained by the students in a semester and will be computed as follows

$$SGPA = \frac{\text{Sum (Course Credit X Number of Grade Points in concern Course Gained by the Student}}{\text{Sum (Course Credit)}}$$

The SGPA will be mentioned on the mark sheet at the end of every semester.

- The Cumulative Grade Point Average (CGPA) will be used to describe the overall performance of a student in all semester of the course and will be computed as under.

$$CGPA = \frac{\text{Sum (All four Semester SGPA)}}{\text{Total Number of Semester}}$$

The SGPA and CGPA shall be rounded off to the second place of decimal.

Grade Card

Results will be declared by the Physics Department and the grade card (containing the grades obtained by the student along with SGPA) will be issued by the university after completion of every semester. The grade card will be consisting of following details.

- Title of the courses along with code opted by the student.
- Credits associated with the course.
- Grades and grade points secured by the student.
- Total credits earned by the student in a particular semester.
- Total credits earned by the students till that semester.
- SGPA of the student.
- CGPA of the student (at the end of the IVth semester).

Cumulative Grade Card

The grade card sheet showing details grades secured by the student in each subject in all semester along with overall CGPA will issued by the University at the end of IVth semester.