SHIVAJI UNIVERISTY, KOLHAPUR-416 004. MAHARASHTRA
PHONE : EPABX-2609000 **website- www.unishivaji.ac.in**
FAX 0091-0231-2691533 & 0091-0231-2692333 – BOS - 2609094
शिवाजी विद्यापीठ, कोल्हापूर – 416004.
दुरध्वनी (ईपीएबीएक्स) २६०९००० (अभ्यास मंडळे विभाग– २६०९०९४)
फॅक्स : ००९१-०२३१-२६९१५३३ व २६९२३३३.e-mail:bos@unishivaji.ac.in

Estd. 1962
NAAC 'A' Grade

SU/BOS/Science/8088 **Date: 13-08-2018**

To,

The Head,
Nano Science & Technology Department
Shivaji University, Kolhapur.

Subject: Regarding syllabi of B.Sc. - M.Sc. Nano Science & Technology (5 Year Integrated Course) Part- I degree programme under the Faculty of Science and Technology.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of question paper and equivalence of B.Sc. - M.Sc. Nano Science & Technology (5 Year Integrated Course) Part- I under the Faculty of Science and Technology.

This syllabi and equivalence shall be implemented from the academic year 2018-2019 (i.e. from June 2018) onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in (Online Syllabus)

The question papers on the pre-revised syllabi of above mentioned course will be set for the examinations to be held in October /November 2018 & March/April 2019. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar

Copy to:

1	The Dean, Faculty of Science & Technology	7	P.G.Seminar Section
2	Director, Board of Examinations and Evaluation	8	Computer Centre
3	The Chairman, Respective Board of Studies	9	Affiliation Section (U.G.)
4	B.Sc. Exam	10	Affiliation Section (P.G.)
5	Eligibility Section	11	P.G.Admission Section
6	Appointment Section		

Shivaji University, Kolhapur.

B. Sc. – M. Sc. Nanoscience and Technology
(5 Years integrated Course)
under CBCS

B. Sc.-M.Sc. Course Structure (5 years integrated course)
&
B. Sc.-M.Sc.Part - I CBCS Syllabus

to be implemented from the academic year 2018-19

(June 2018) onwards.

Shivaji University, Kolhapur

Regulations and Guidelines

Choice Based Credit System (CBCS)

I. B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course)

II. B. Sc. Nanoscience and Technology (3 years course/Lateral Exit)

III. M. Sc. Nanoscience and Technology (2 years course/Lateral Entry)

Programs

Under the Faculty of Science & Technology

(To be implemented from Academic Year 2018-19)

1. **Implementation of Regulations & Guidelines:** The Regulations & guidelines shall be implemented gradually for the three programs as mentioned below –

   I.B.Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Program.

   a) B.Sc.-M. Sc. (5 years integrated course) Part – I from Academic year 2018- 19
   b) B.Sc. -M. Sc. (5 years integrated course) Part – II from Academic year 2019- 20
   c) B.Sc. -M. Sc. (5 years integrated course) Part – III from Academic year 2020- 21
   d) B.Sc. -M. Sc. (5 years integrated course) Part – IV from Academic year 2021- 22
   e) B.Sc. -M. Sc. (5 years integrated course)Part – V from Academic year 2023- 24

   II.B.Sc. Nanoscience and Technology (lateral exit) Program.

   a) B.Sc. (3 year) Part – I from Academic year 2018- 19
   b) B.Sc. (3 year) Part – II from Academic year 2019- 20
   c) B.Sc. (3 year) Part – III from Academic year 2020- 21

   III.M. Sc. Nanoscience and Technology (lateral entry) Program.

   a) M. Sc. (2 year) Part – I from Academic year 2018- 19
   b) M. Sc. (2 year) Part – II from Academic year 2019- 20

2. Eligibility Criteria:

I. B. Sc.-M. Sc. Nanoscience and Technology(5 years integrated course) Program.

12^{th} Science (A or B or Both groups) are eligible. The candidate passed in 12^{th}science examination with minimum 45% marks for open category and 40%marks for the reserved category are eligible for application.

II. B.Sc. Nanoscience and Technology(lateral exit) Program.

12^{th} Science (A or B or Both groups) are eligible. The candidate passed in 12^{th}science examination with minimum 45% marks for open category and 40%marks for the reserved category are eligible for application

III.M. Sc. Nanoscience and Technology (lateral entry) Program

B.Sc. in Nanoscience& Technology or B. Sc. Nanotechnology. The candidates passed in B. Sc. examination with minimum 45% marks for open category and 40%marks for the reserved category are eligible for application. Admission will be through entrance examination conducted by Shivaji University.

3. Eligibility Conditions for foreign Students:

As per university rule.

4. Duration and Pattern of program: The duration for CBCS Programs, I, II and III are given below.

I. B.Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Program will be of 5 years. The pattern of CBCS will be of semester type. There shall be 10 semesters each of 6 months duration.

II. B. Sc. Nanoscience and Technology (lateral exit) Program will be of 3 years. The pattern of CBCS will be semester type. There shall be 6 semesters each of 6 months duration.

III. M. Sc. Nanoscience and Technology (lateral entry) Program will be of 2 years. The pattern of CBCS will be semester type. There shall be 4 semesters each of 6 months duration.

5. Weightage: There shall be:

I. B. Sc.-M. Sc. Nanoscience and Technology(5 year integrated course) Program.

6600 marks for 5 years B. Sc.-M. Sc. Nanoscience and Technology CBCS Program with 260Credits.

II. B.Sc. Nanoscience and Technology (lateral exit) Program.

4500 for 3 years B. Sc. Nanoscience and Technology CBCS Program with 180 credits.

III.M. Sc. Nanoscience and Technology(lateral entry) Program.

2200 marks for 2 years M. Sc. Nanoscience and Technology CBCS with 80 credits.

I. B. Sc.-M. Sc. Nanoscience and Technology(5 years integrated course) Program. details are:

a) **B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course)Part – I (Sem I & II) :**

For B. Sc.-M. Sc. Part I total Credits shall be 60 with 30 Credits for each Semester, of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be Ability Enhancement Compulsory Course (subjects) (hereafter termed as AECC1) with Paper A for Sem I and Paper B for Sem II each of 50 marks, as compulsory English course.

(ii) There shall be 5 Discipline Specific Core Courses (subjects) (hereafter termed as DSC) per semester.

(iii) There shall be 5 theory papers each of 100 marks for a DSC.

(iv) There shall be 4 practical of 50 marks for each DSC per semester.

b) **B. Sc.-M. Sc. . Nanoscience and Technology (5 years integrated course) Part – II (Sem III & IV) :**

For B. Sc.-M. Sc. Part II total Credits shall be 60 with 32 Credits for Sem III and 28 Credits for Sem IV. For Sem III there shall be 24 Credits for theory and 8 credits for practical and for Sem IV there shall be 20 credits for theory and 8 credits for practical.

(i) There shall be one AECC2 with Paper C (Theory – 70 marks) and Paper D (Project – 30 marks) as compulsory Environmental Studies course. The examination shall be conducted at the end of Sem IV. The Credits of the Environmental Studies course shall be assigned at the end of Sem IV.

(ii) There shall be 5 DSC (subjects) per semester.

(iii) There shall be 5 theory papers each of 100 marks for a DSC.

(iv) There shall be 4 practical of 50 marks for each DSC per semester.

c) **B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Part – III (Sem V & VI) :**

For B. Sc.-M. Sc. Part III total Credits shall be 60 with 30 Credits for each Semester of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be SEC1 with Paper E for Sem V and Paper F for Sem VI each of 50 marks.

(ii) There shall be one Discipline Specific Elective (hereafter termed as DSE) as a special course (subject).

(iii) There shall be 5 theory papers each of 100 marks for a DSE per semester.

(iv) There shall be 4 practical of 50 marks for DSE+SEC subjects per semester.

d) **B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Part – IV (Sem VII& VIII):**

For B. Sc.-M. Sc. Part IV total Credits shall be 60 with 30 Credits for each Semester of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be 5 theory papers each of 100 marks for CP (Core Paper) and additional 1 theory paper for CP each of 50 marks per semester

(ii) There shall be 4 practical of 50 marks for CP subjects per semester.

e) **B. Sc.-M. Sc.Nanoscience and Technology (5 years integrated course). Part – V (Sem IX & X):**

For B. Sc.-M. Sc. Part V total Credits shall be 20 with 10 Credits for each Semester. Both the semesters are dedicated to Research Project.

II. B.Sc. Nanoscience and Technology (lateral exit) Program details are:

a) **B.Sc. Nanoscience and Technology Part – I (Sem I & II) :**

For B. Sc. Part I total Credits shall be 60 with 30 Credits for each Semester, of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be Ability Enhancement Compulsory Course (subjects) (hereafter termed as AECC1) with Paper A for Sem I and Paper B for Sem II each of 50 marks, as compulsory English course.

(ii) There shall be 5 Discipline Specific Core Courses (subjects) (hereafter termed as DSC) per semester.

(iii) There shall be 5 theory papers each of 100 marks for a DSC.

(iv) There shall be 4 practical of 50 marks for each DSC per semester.

b) **B. Sc. Nanoscience and Technology Part –II (Sem III & IV) :**

For B. Sc. Part II total Credits shall be 60 with 32 Credits for Sem III and 28 Credits for Sem IV. For Sem III there shall be 24 Credits for theory and 8 credits for practical and for Sem IV there shall be 20 credits for theory and 8 credits for practical.

(i) There shall be one AECC2 with Paper C (Theory – 70 marks) and Paper D (Project – 30 marks) as compulsory Environmental Studies course. The examination shall be conducted at the end of Sem IV. The Credits of the Environmental Studies course shall be assigned at the end of Sem IV.

(ii) There shall be 5 DSC (subjects) per semester.

(iii) There shall be 5 theory papers each of 100 marks for a DSC.

(iv) There shall be 4 practical of 50 marks for each DSC per semester.

c) **B.Sc. Nanoscience and Technology Part –III (Sem V & VI):**

For B. Sc. Part III total Credits shall be 60 with 30 Credits for each Semester of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be SEC1 with Paper E for Sem V and Paper F for Sem VI each of 50 marks.

(ii) There shall be one Discipline Specific Elective (hereafter termed as DSE) as a special course (subject).

(iii) There shall be 5 theory papers each of 100 marks for a DSE per semester.

(iv) There shall be 4 practical of 50 marks for DSE+SEC subjects per semester.

III. M. Sc. Nanoscience and Technology(lateral entry) Program details are:

a) **M. Sc. Nanoscience and Technology Part –I (Sem I & II):**

For M. Sc. Part I total Credits shall be 60 with 30 Credits for each Semester of these; there shall be 22 Credits for theory and 8 credits for practical per semester.

(i) There shall be 5 theory papers each of 100 marks for CP (Core Paper) and additional 1 theory paper for CP each of 50 marks per semester

(ii) There shall be 4 practical of 50 marks for CP subjects per semester.

b) **M. Sc. Nanoscience and Technology Part –II (Sem III & IV):**

For M. Sc. Part II total Credits shall be 20 with 10 Credits for each Semester. Both the semesters are dedicated to Research Project.

CreditdistributionchartforB.Sc. –M. Sc. Nanoscience and Technology/B. Sc. Nanoscience and Technology/M. Sc. Nanoscience and TechnologyProgramwithCourseCode

CourseName	TotalCourses(Papers)	TotalCredits	%intotalcours
DSC:DisciplineSpecific CoreCourse	36	112	43
AECC:AbilityEnhancementCompulsoryCourses	04	08	05
DSE:DisciplineSpecific Elective	18	56	21
SEC: Skill Enhancement Course	02	04	02
CP: Core Paper	24	80	29
TOTAL	**84**	**260**	**100**

6. **Regarding the examination –** Rules, Regulations and Ordinance of Regular Mode for B. Sc. and M. Sc. CBCS Program of Shivaji University Kolhapur.

   External examinations for 80 marks and Internal Examination of 20 Marks for all the Papers and course. The Results of the Examination will be declared on the basis of Credits gained and Grades achieved.

7. **Practical examinations** – There shall be the semester system of examination in respect of practical examinations for

   I. B.Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) program.

   II. B. Sc. Nanoscience and Technology program

   III. M. Sc. Nanoscience and Technology program.

   The rules for practical examinations shall be as per the letter / circular issued by respective Board of Studies time to time.

8. **Equivalence of papers and chances for the students in previous** – semester pattern – Two additional chances shall be provided for the repeater students of the

   I. B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated) Program

   II. B. Sc. Nanoscience and Technology Program

   III. M. Sc. Nanoscience and Technology Program.

   After this the concerned students will have to appear for the examination as per this revised scheme.

9. **Standard of passing**

   I. B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Program

   a) For B.Sc.-M. Sc. Part – I (Sem I & II)

   Except English, there shall be combined passing for five theory papers of 100 marks each for each course (subject) i.e. minimum 35 marks out of 100 are required for passing. External Examination will be of 80 marks for each subject and a separate passing marks of 28 and Internal Examination marks will be of 20 marks with separate passing mark of 7. There shall be separate passing for theory and practical courses. Minimum 18 marks out of 50 are

required for passing of practical examination of each course. For English theory exam, minimum 18 marks out of 50 are required for passing.

ThereshallbeaCompulsoryCivicCourse(CCC)entitled“Democracy,ElectionsandGoodGovernance”forSemIandoneSkillDevelopmentCourse(SDC)forSemII.(CBCSR.B.Sc.3) of B. Sc. Part I, II, III CBCS under the Faculty of Science and Technology (Ref. No. SU/BOS/Science/4749 dated. 01.06.2018).

b) For B. Sc.-M. Sc.Part– II (Sem III & IV)

Except Environmental Studies, there shall be combined passing for five theory papers of 100 marks each for each course (subject) i.e. minimum 35 marks out of 100 are required for passing. External Examination will be of 80 marks for each subject and a separate passing marks of 28 and Internal Examination marks will be of 20 marks with separate passing marks of 7. There shall be separate passing for theory and practical courses. Minimum 18 marks out of 50 are required for passing of practical examination of each course. For Environmental Studies theory paper minimum 25 out of 70 and for project minimum 10 marks out of 30 are required for passing. There shall be separate passing for theory and project examination for Environmental Studies.

c) For B. Sc.-M. Sc.Part– III (Sem V & VI)

Except SEC1, there shall be combined passing for five theory papers of 100 marks each for each course (subject) i.e. minimum 35 marks out of 100 are required for passing. External Examination will be of 80 marks for each subject and a separate passing marks of 28 and Internal Examination marks will be of 20 marks with separate passing marks of 7. There shall be separate passing for theory and practical courses. Minimum 18 marks out of 50 are required for passing of practical examination of each course.For SEC1 theory paper minimum 18 out of 50 is required for passing.

Forthecandidate/studentinSem-Vitiscompulsorytoappearforthepaperentitled,“ConstitutionofIndia&LocalSelfGovernment”.ForSemVIoneSkillDevelopmentCourse(SDC)(CBCSR.B.S

c.3).Thestudymaterialofthesyllabusforabovestatedpaperwillbeavailableonwww.unishivaji.ac.in

Thesubjectstatedabovehastobelearntunderself-studymode.Theexaminationwillhavemaximum50marksandnatureofexaminationwillbeofmultiplechoicetypes.Minimum20marks(40%)outof50arerequiredforpassing.

Theexaminationofabovesubjecthastobeconductedlocallyinthecollege.Thecertificateofthesuccessfulcandidates/studentshastobeissuedbythePrincipal/Head of the Department/Co-ordinator/ Director ofthecollege/Department/School.ThemarklistofpassedcandidatestobecommunicatedtoexaminationdepartmentofShivajiUniversity,Kolhapurwithindueti me.

Thestudent/candidatewhofailedtoscoreminimummarks(20marks)inthesaidpaperwilldisqualifiedtoclaimthedegreecertificate.

d) For B. Sc.-M. Sc. Part– IV (Sem VII& VIII)

Core Papers (CP) shall be introduced. Except CP-6 and CP-12, there shall be combined passing for five theory papers of 100 marks each for each course (subject) i.e. minimum 35 marks out of 100 are required for passing. External Examination will be of 80 marks for each subject and a separate passing marks of 28 and Internal Examination marks will be of 20 marks with separate passing marks of 7. There shall be separate passing for theory and practical courses. Minimum 18 marks out of 50 are required for passing of practical examination of each course.For CP-6 and CP-12 theory paper minimum 18 out of 50 is required for passing.

e) For B. Sc.-M. Sc. Part– V (Sem IX & X)

The evaluation is completely based on Research Project evaluation. There shall be 200 marks for Research Project dissertations and 100 marks for Project related seminars. A minimum of 70 marks out of 200 marks and 35 marks out of 100 marks is required for passing. Except CP-6 and CP-12, there shall be combined passing for five theory papers of 100 marks each for each course (subject) i.e. minimum 35 marks out of 100 are required for passing. External Examination will be of 70 marks for each subject and a separate passing marks of 28 and Internal Examination marks will be of 20

marks with separate passing marks of 7. There shall be separate passing for theory and practical courses. Minimum 18 marks out of 50 are required for passing of practical examination of each course.For CP-6 and CP-12 theory paper minimum 18 out of 50 is required for passing.

10. Gradation Chart :

Marks Obtained	Numerical Grade (Grade Point)		CGPA	Letter Grade
Absent	0 (zero)		-	-
0 – 34	0 (zero)		0.0 – 4.99	F (Fail)
35 – 44	5		5.00 – 5.49	C
45 – 54	6		5.50 – 6.49	B
55 – 64	7		6.50 – 7.49	B+
65 – 74	8		7.50 – 8.49	A
75 – 84	9		8.50 – 9.49	A+
85 – 100	10		9.50 – 10.0	O (Outstanding)

Note:

1. Marks obtained > = 0.5 shall be rounded off to next higher digit.
2. The SGPA & CGPA shall be rounded off to 2 decimal points.
3. Marks obtained in 50 marks or 200 marks paper shall be converted to 100 marks.

Calculation of SGPA & CGPA

1. Semester Grade Point Average **(SGPA)**

$$\mathbf{SGPA} = \frac{\sum(\text{Course credits} \times \text{Grade points obtained}) \text{ of a semester}}{\sum(\text{Course credits}) \text{ of respective semester}}$$

2. Cumulative Grade Point Average **(CGPA)**

$$\mathbf{CGPA} = \frac{\sum(\text{Total credits of a semester} \times \text{SGPA of respective semester}) \text{ of all semesters}}{\sum(\text{Total course credits}) \text{ of all semesters}}$$

11. **Result** - The result of each semester shall be declared as Pass or Fail. However, ATKT rules will be followed for theory and practical passing.
12. Revised Rules - These revised rules will be gradually implemented with effect from the academic year 2018 -19 for B.Sc. i.e. Part I, Part II, Part III. However, the existing (i.e. pre-revised) rules shall remain in force for the students of semester pattern during the transition period.

B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Program

B. Sc. –M. Sc. Nanoscience and Technology	Credits	Marks
Part I	60	1500
Part II	60	1500
Part III	60	1500
Part IV	60	1500
Part V	20	600
Total	**260**	**6600**

The following shall be the courses of the studies under CBCS pattern

B. Sc. - M. Sc. Nanoscience and Technology (5 years integrated course) – I CBCS PATTERN (2018-19)

S E M E S T E R – I (Duration – 6 Months)																		
Sr. No	Course Title	**Teaching Scheme**						**Examination Scheme**										
								Theory								Practical		
		Theory			Practical			External			Internal			Total		Total		
		No.of lectures	Hours	Credits	No. of Lectures	Hours	Credits	Max.	Min.	Hours	Max.	Min.	Hours	Max.	Min.	Max.	Min.	Hours
1	DSC-1A-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSC-2A-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSC-3A-Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSC-4A-Maths.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSC-5A- Elect.	4	4	4				80	28	3	20	7	1	100	35			
6	AECC1-6A-Eng.	2	2	2	-	-	-	40	14	2	10	4	0.5	50	20	-	-	-
	Total	22	22	**22**	16	16	**8**	440			110	-	5	550	-	200		16
	Semester-II (duration 6 months)																	
1	DSC-1B-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSC-2B-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSC-3B- Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSC-4B-Maths.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSC-5B- Elect.	4	4	4				80	28	3	20	7	1	100	35			
6	AECC1-6B-Eng.	2	2	2	-	-	-	40	14	2	10	4	0.5	50	18	-	-	-
	Total	22	22	**22**	16	16	**8**	440			110		-	550		200	-	16
	Grand Total	44	44	**44**	32	32	**16**							1100		400		

- Student contact hours per week : 38 Hours (Min.)
- Total Marks for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course I (Including English) : **1500**
- Theory lectures: 60 Minutes Each
- Practical lectures: 60 Minutes Each
- Total Credits for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-I (Semester I & II) : **60**
- **AECC**- Ability Enhancement Compulsory Course (1-6A & 1-6B)- English
- **DSC**-Discipline Specific Core. (for Semester I--A and for semester II--B)
- Course list as per enclosed Annexure. ***Separate passing is mandatory for Theory, Internal and Practical.***
- Practical Examination will be conducted at semester end for 50 Marks per DSC course (subject).
- **A)Non-CreditSelfStudyCourse:CompulsoryCivicCourses(CCC)ForSemI:CCC–I:**Democracy,ElectionsandGoodGovernance

(B)Non-CreditSelfStudyCourse:SkillDevelopmentCourses(SDC)ForSemII:SDC–I: Anyonefromfollowing(i)to(v)

i)BusinessCommunication&Presentationii)Eventmanagementiii)PersonalityDevelopment,iv)Yoga&PhysicalManagement, v)Resume,Report&proposalwriting.

The following shall be the courses of the studies under CBCS pattern

B. Sc. - M. Sc. Nanoscience and Technology (5 years integrated course) – II CBCS PATTERN (2019-20)

S E M E S T E R – III (Duration – 6 Months)																		
Sr. No	Course Title	**Teaching Scheme**						**Examination Scheme**										
								Theory								Practical		
		Theory			Practical			External			Internal			Total		Total		
		No. of lectures	Hours	Credits	No. of Lectures	Hours	Credits	Max.	Min.	Hours	Max.	Min.	Hours	Max.	Min.	Max.	Min.	Hours
1	DSC-7C-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSC-8C-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSC-9C-Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSC-10C-Maths.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSC-11C- Elect.	4	4	4				80	28	3	20	7	1	100	35			
6	AECC2-12C-Env.	4	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	24	24	**24**	16	16	**8**	400			100	-	5	500	-	200		16
	Semester-IV (duration 6 months)																	
1	DSC-7D-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSC-8D-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSC-9D- Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSC-10D-Maths.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSC-11D- Elect.	4	4	4				80	28	3	20	7	1	100	35			
6	AECC2-12C-Env	-	-	-	-	-	-	70	25	3	-	-	-	100	35	-	-	-
	AECC2-12D-Env.							30	10									
	Total	20	20	**20**	16	16	**8**	500	-		100		-	600		200	-	16
	Grand Total	44	44	**44**	32	32	**16**	-	-		-		-	1100	-	400	-	

- Student contact hours per week : 38 Hours (Min.)
- Theory lectures: 60 Minutes Each
- Practical lectures: 60 Minutes Each
- Total Marks for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course.-II (Including English) : **1500**
- Total Credits for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-II (Semester III & IV) : **60**
- **AECC**- Ability Enhancement Compulsory Course (2-12C & 2-12D)- Environmental Science
- **DSC**-Discipline Specific Core. (for Semester III--C and for semester IV--D)
- Course list as per enclosed Annexure. ***Separate passing is mandatory for Theory, Internal and Practical.***
- Practical Examination will be conducted at semester end for 50 Marks per DSC course (subject).

The following shall be the courses of the studies under CBCS pattern

B. Sc. - M. Sc. Nanoscience and Technology (5 years integrated course) – III CBCS PATTERN (2020-21)

S E M E S T E R – V (Duration – 6 Months)																		
Sr. No	Course Title	**Teaching Scheme**						**Examination Scheme**										
								Theory								Practical		
		Theory			Practical			External			Internal			Total		Total		
		No.of lectures	Hours	Credits	No. of Lectures	Hours	Credits	Max.	Min.	Hours	Max.	Min.	Hours	Max.	Min.	Max.	Min.	Hours
1	DSE-1E-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSE-2E-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSE-3E-Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSE-4E-Nanoscale Sc.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSE-5E-Nnotechnology	4	4	4				80	28	3	20	7	1	100	35			
6	SEC-1E-Nanomedicine & Env.Nanotech.-I	2	2	2				40	14	2	10	4	0.5	50	18	-	-	-
	Total	22	22	**22**	20	20	**8**	400			100	-	5	550	-	200		16
	Semester-VI (duration 6 months)																	
1	DSE-1F-Phy.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	DSE-2F-Chem.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	DSE-3F- Biotech.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	DSE-4F-Properties of Nanomat.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	DSE-5F- Elements of Nuclear Physics and Chemistry	4	4	4				80	28	3	20	7	1	100	35			
6	SEC-1F-Nanomedicine & Env. Nanotech.-II	2	2	2				40	14	2	10	4	0.5	50	18	-	-	-
	Total	22	22	**22**	20	20	**8**	440			110		-	550		200	-	16
	Grand Total	44	44	**44**	40	40	**16**							1100		400		

- Student contact hours per week : 20 Hours (Min.)
- Theory lectures: 60 Minutes Each
- Practical lectures: 60 Minutes Each
- Total Marks for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course -III (Including SEC1) : **1500**
- Total Credits for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-III (Semester V & VI) : 60
- **SEC**- Skill Enhancement Course (1-6A & 1-6B)- Nanomedicine & Env. Nanotech.
- **DSE**-Discipline Specific Elective. (for Semester V--E and for semester VI--F)
- Course list as per enclosed Annexure. ***Separate passing is mandatory for Theory, Internal and Practical.***
- Practical Examination will be conducted at semester end for 50 Marks per DSE course (subject).
- **(A)Non-CreditSelfStudyCourse:CompulsoryCivicCourses(CCC)ForSemV:CCC–II**:ConstitutionofIndiaandLocalSelfGovernment

(B)Non-CreditSelfStudyCourse:SkillDevelopmentCourses(SDC)ForSemVI:SDC–II: Anyonefromfollowing(vi)to(x)vi)Interview&PersonalPresentationSkill,vii)EntrepreneurshipDevelopmentSkill,viii)Travel&Tourism,ix)E-Banking&FinancialServices,x)RTI&HumanRightEducation(HRE),IPR&Patents

The following shall be the courses of the studies under CBCS pattern

B. Sc. - M. Sc. (5 years integrated course) – IV C B C S PATTERN (2021-22)

S E M E S T E R – VII (Duration – 6 Months)																		
Sr. No	Course Title	**Teaching Scheme**						**Examination scheme**										
								Theory								Practical		
		Theory			Practical			External			Internal			Total		Total		
		No.of lectures	Hours	Credits	No. of Lectures	Hours	Credits	Max.	Min.	Hours	Max.	Min.	Hours	Max.	Min.	Max.	Min.	Hours
1	CP-1-Semiconductor Physics	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	CP-2-Carbaneous Materials.	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	CP-3-Functional Nanomaterials	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	CP-4-Nanocoatings and Applications	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	CP-5-Nanobiotechnology	4	4	4				80	28	3	20	7	1	100	35			
6	CP-6-Quantum Physics and Chemistry.	2	2	2	-	-	-	40	14	2	10	4	0.5	50	18	-	-	-
	Total	22	22	**22**	16	16	**8**	440			110	-	5	550		200		16
	Semester-VIII (duration 6 months)																	
1	CP-7-Solid State Electronic Devices	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
2	CP-8-Energy Conversion and Storage Devices	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
3	CP-9-Nanocatalysis	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
4	CP-10-Nanomagnetism and Spintronics	4	4	4	4	4	2	80	28	3	20	7	1	100	35	50	18	4
5	CP-11-Biomedical Application of Nanobiotechnology	4	4	4				80	28	3	20	7	1	100	35			
6	CP-12-Classical and Statistical Thermodynamics	2	2	2	-	-	-	40	28	2	10	4	0.5	50	18	-	-	
	Total	22	22	**22**	16	16	**8**	440			110		-	550	-	200	-	16
	Grand Total	44	44	**44**	32	32	**16**				-			1100	-	400		

- Student contact hours per week : 38 Hours (Min.)
- Theory lectures: 60 Minutes Each
- Practical lectures: 60 Minutes Each
- Total Marks for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-IV : **1500**
- Total Credits for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-IV (Semester VII & VIII) : **60**
- Course list as per enclosed Annexure. ***Separate passing is mandatory for Theory, Internal and Practical.***
- Practical Examination will be conducted at each semester end for 50 Marks.

The following shall be the courses of the studies under CBCS pattern

B. Sc. - M. Sc. (5 years integrated course) – V C B C S PATTERN (2022-23)

S E M E S T E R – IX (Duration – 6 Months)							
Sr. No	Course Title	**Teaching Scheme**		**Examination scheme**			
		Theory	Practical	Practical		Total	
		Credits		Maximum	Minimum	Maximum	Minimum
1	CP-13-Research project and Dissertation Phase I	8		200	70	300	120
2	CP-14-Seminar based on project work I	2		100	35		
Semester-X (duration 6 months)							
1	CP-15-Research project and Dissertation Phase II	8		200	70	300	120
2	CP-16-Seminar based on project work II	2		100	35		

• Student contact hours per week : 20 Hours (Min.)	• Total Marks for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-V : **600**
• Total Credits for B.Sc.-M. Sc. Nanoscience and Technology (5 year integrated course)-V (Semester IX &X) : **20**	
• Course list as per enclosed Annexure. ***Separate passing is mandatory for each course.***	

R. B. Sc.-M. Sc. Nanoscience and Technology (5 years integrated course) Program:

List of courses: B. Sc.-M. Sc. Part I (Sem I & II), Part II (Sem III & IV), Part III (Sem V & VI), Part IV (Sem VII & VIII), Part III (Sem IX & X)

Sem I : DSC – 1A to 6A (Theory) & 1A to 5A (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part I: Sem I DSC – 1A to 6A	
DSC-1A-Phy.	Mechanics
DSC-2A-Chem.	Atomic Structure, Bonding, General organic Chemistry and Aliphatic hydrocarbons
DSC-3A-Biotech.	Cell biology
DSC-4A-Maths.	Differential Calculus
DSC-5A- Elect.	Network Analysis and Analogy Electronics
AECC1-6A-Eng.	English-I

Course code	Name of Course
B. Sc.-M. Sc.-Part I: Sem I DSC – 1A to 4A-Lab.	
DSC-1A-Phy.-Lab.	Physics Lab. 1
DSC-2A-Chem.-Lab	Chemistry Lab. 1
DSC-3A-Biotech.-Lab.	Biotechnology Lab. 1
DSC-4A- & DSC-5A- Lab.	Mathematics and Electronics Lab. 1

DSC: Discipline Specific Core Course
AECC – Ability Enhancement Compulsory Course
AECC6 – A – English – I
A)Non-CreditSelfStudyCourse:CompulsoryCivicCourses(CCC)ForSemI:CCC–I: Democracy ElectionsandGoodGovernance.

Sem II : DSC – 1B to 6B (Theory) & 1B to 5B (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part I: Sem II DSC – 1B to 6B	
DSC-1B-Phy.	Electricity and Magnetism
DSC-2B-Chem.	Chemical Energetics, Equilibria & Functional Organic Chemistry
DSC-3B-Biotech.	Mammalian Physiology
DSC-4B-Maths.	Differential Equations
DSC-5B- Elect.	Linear and Digital Integrated Circuits
AECC1-6B-Eng.	English II

Course code	Name of Course
B. Sc.-M. Sc.-Part I: Sem II DSC – 1B to 5B-Lab.	
DSC-1B-Phy.-Lab.	Physics Lab. 2
DSC-2B-Chem.-Lab	Chemistry Lab. 2
DSC-3B-Biotech.-Lab.	Biotechnology Lab. 2
DSC-4B- & DSC-5B- Lab.	Mathematics and Electronics Lab. 2

DSC: Discipline Specific Core Course
AECC – Ability Enhancement Compulsory Course
AECC6 – B– English – II
(B)Non-CreditSelfStudyCourse:SkillDevelopment Courses(SDC)ForSemII:SDC–I: Anyonefrom following(i)to(v):
i)BusinessCommunication&Presentationii)Eventmanagementiii)PersonalityDevelopment,iv)Yoga&PhysicalManagementv)Resume,Report&proposalwriting

Sem III: DSC – 7C to 12C(Theory) & 7C to 11C (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part II: Sem III DSC – 7C to 12C	
DSC-7C-Phy.	to be implemented in 2019-2020
DSC-8C-Chem.	to be implemented in 2019-2020
DSC-9C-Biotech.	to be implemented in 2019-2020
DSC-10C-Maths.	to be implemented in 2019-2020
DSC-11C- Elect.	to be implemented in 2019-2020
AECC2-12C-Env.	Environmental Science

Course code	Name of Course
B. Sc.-M. Sc.-Part II: Sem III DSC – 7C to 11C-Lab.	
DSC-7C-Phy.-Lab.	Physics Lab. 3
DSC-8C-Chem. -Lab	Chemistry Lab. 3
DSC-9C-Biotech.-Lab.	Biotechnology Lab. 3
DSC-10C- & DSC-11C-Lab.	Mathematics and Electronics Lab. 3

DSC: Discipline Specific Core Course
AECC – Ability Enhancement Compulsory Course
AECC2 – C – Environmental Science

Sem IV: DSC – 7D to 12D (Theory) & 7D to 11D (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part II: Sem IV DSC – 7D to 12D	
DSC-7D-Phy.	to be implemented in 2019-2020
DSC-8D-Chem.	to be implemented in 2019-2020
DSC-9D-Biotech.	to be implemented in 2019-2020
DSC-10D-Maths.	to be implemented in 2019-2020
DSC-11D-Elect.	to be implemented in 2019-2020
AECC2-12D-Env.	Environmental Science

Course code	Name of Course
B. Sc.-M. Sc.-Part II: Sem IV DSC – 7D to 11D-Lab.	
DSC-7D-Phy.-Lab.	Physics Lab. 4
DSC-8D-Chem. -Lab	Chemistry Lab. 4
DSC-9D-Biotech.-Lab.	Biotechnology Lab. 4
DSC-10D- & DSC-11D-Lab.	Mathematics and Electronics Lab. 4

DSC: Discipline Specific Core Course
AECC – Ability Enhancement Compulsory Course
AECC2 – D– Environmental Science

Sem V: DSE – 1E to 6E (Theory) & 1E to 4E (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part III: Sem V DSE – 1E to 6E	
DSE-1E-Phy.	to be implemented in 2020-2021
DSE-2E-Chem.	to be implemented in 2020-2021
DSE-3E-Biotech.	to be implemented in 2020-2021
DSE-4E-Nanoscale Sc.	Science at Nanoscale
DSE-5E-Nanotechnology	Nanotechnology
SEC1-6E-Nanomedicin & Env. Nanotech-I.	Nanomedicine and Environmental Nanotechnology-I

Course code	Name of Course
B. Sc.-M. Sc.-Part III: Sem V DSE – 1E to 4E-Lab.	
DSE-1E-Phy.-Lab.	Physics Lab. 5
DSE-2E-Chem. -Lab	Chemistry Lab. 5
DSE-3E-Biotech.-Lab.	Biotechnology Lab. 5
DSE-4E- & SEC1-6E-Lab.	Science at Nanoscale & Nanomedicine & Env. Nanotech.-Lab.-1

DSE: Discipline Specific Elective Course
SEC – Skill Enhancement Course
SEC1 – E – Nanomedicine and Environmental Nanotechnology
(A)Non-CreditSelfStudyCourse:CompulsoryCivicCourses(CCC)ForSemV:CCC–II:ConstitutionofIndiaandLocalSelfGovernment

Sem VI: DSE – 1F to 6F(Theory) & 1F to 4F (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part III: Sem VI DSE – 1F to 6F	
DSE-1F-Phy.	to be implemented in 2020-2021
DSE-2F-Chem.	to be implemented in 2020-2021
DSE-3F-Biotech.	to be implemented in 2020-2021
DSE-4F-Properties of Nanomat.	Properties of Nanomaterials
DSE-5F- Elements Nuclear Physics and Chemistry	Elements Nuclear Physics and Chemistry
SEC1-6F-Nanomedicin & Env. Nanotech-I.	Nanomedicine and Environmental Nanotechnology-II

Course code	Name of Course
B. Sc.-M. Sc.-Part III: Sem VI DSE – 1Fto 4F-Lab.	
DSE-1F-Phy.-Lab.	Physics Lab. 6
DSE-2F-Chem. -Lab	Chemistry Lab. 6
DSE-3F-Biotech.-Lab.	Biotechnology Lab. 6
DSE-4F- & SEC1-6E -Lab.	Properties of Nanomaterials& Nanomedicine & Env. Nanotech.-Lab.-2

DSE: Discipline Specific Elective Course
SEC – Skill Enhancement Course
SEC1 – F– Nanomedicine and Environmental Nanotechnology
(B)Non-CreditSelfStudyCourse:SkillDevelopmentCourses(SDC)ForSemVI: SDC–II: Anyonefromfollowing(vi)to(x):
vi)Interview&PersonalPresentationSkill,vii)EntrepreneurshipDevelopmentSkill,viii)Travel&Tourism,ix)E-Banking&FinancialServices,x)RTI&HumanRightEducation(HRE),IPR&Patents

Sem VII: CP – 1to 6 (Theory) & 1 to 5 (Practical)

Course code	Name of Course
B. Sc.-M. Sc.-Part IV: Sem VII CP –1 to 6	
CP-1-Semiconductor Physics	Semiconductor Physics
CP-2-Carbaneous Materials.	Carbaneous Materials.
CP-3-Functional Nanomaterials	Functional Nanomaterials
CP-4-Nanocoatings and Applications	Nanocoatings and Applications
CP-5-Nanobiotechnology	Nanobiotechnology
CP-6-Quantum Physics and Chemistry.	Quantum Physics and Chemistry.

CP: Core Paper Course

Course code	Name of Course
B. Sc.-M. Sc.-Part IV: Sem VII CP – 1 to 5-Lab.	
CP-1-Lab.	Semiconductor Physics Lab.
CP-2-Lab.	Carbaneous Materials. –Lab.
CP-3& CP-4 – Lab.	Functional Nanomaterials & Nanocoatings and Applications .-Lab.
CP-5-Lab.	Nanobiotechnology-Lab.

Sem VIII: CP-7-12

Course code	Name of Course
B. Sc.-M. Sc.-Part IV: Sem VIII CP – 7 to 12	
CP-7-Solid State Electronic Devices	Solid State Electronic Devices
CP-8-Energy Conversion and Storage Devices	Energy Conversion and Storage Devices
CP-9-Nanocatalysis	Nanocatalysis
CP-10-Nanomagnetism and Spintronics	Nanomagnetism and Spintronics
CP-11-Biomedical Application of Nanobiotechnology	Biomedical Application of Nanobiotechnology
CP-12-Classical and Statistical Thermodynamics	Classical and Statistical Thermodynamics

CP: Core Paper Course

Course code	Name of Course
B. Sc.-M. Sc.-Part IV: Sem VIII CP – 7 to 11-Lab.	
CP-7- Lab.	Solid State Electronic Devices-Lab.
CP-8-Lab.	Energy Conversion and Storage Devices–Lab.
CP-9 –Lab.	Nanocatalysis -Lab.
CP-11-Lab.	Biomedical Application of Nanobiotechnology-Lab.

Sem IX: CP – 13 & 14

Course code	Name of Course
B. Sc.-M. Sc.-Part V: Sem IX CP –13 and 14	
CP-13-Research project and Dissertation Phase I	Research project and Dissertation Phase I
CP-14-Seminar based onproject work I	Seminar based on project work I

CP: Core Paper Course

Sem XI: CP-15 & 16

Course code	Name of Course
B. Sc.-M. Sc.-Part V: Sem X CP– 15 and 16	
CP-15-Research project and Dissertation Phase II	Research project and Dissertation Phase II
CP-16-Seminar based on project work II	Seminar based on project work II

CP: Core Paper Course

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. –M.Sc. Part – I, Semester- I

Physics-Paper- I

DSC- 1A-Phys.: MECHANICS

(Theory: 60 Lectures)

Unit-I

1. Vectors (4 Lectures)

Vector algebra, Scalar and vector products, Derivatives of a vector with respect to a parameter (velocity and acceleration).

2.Ordinary Differential Equations: (6 Lectures)

Differential equation; ordinary and partial differential equations, 1^{st} order homogeneous differential equations, 2^{nd} order homogeneous differential equations with constant coefficients. Examples.

3. Laws of Motion: (5 Lectures)

Frames of reference, Newton's Laws of motion (with proof). Motion at nanoscale.

Unit -II

Momentum and Energy: (9 Lectures)

Conservation of linear and angular momentum, work and energy theorem, conservation of energy (Single particle), Dynamics of a system of particles (linear momentum, angular momentum and energy), Center of mass, Motion of rockets (qualitative treatment only).

Rotational Motion: (6 Lectures)

Angular velocity, angular momentum and Torque, Kinetic energy of rotation and moment of Inertia, Moment of inertia of a spherical shell, solid cylinder (only about axis of symmetry), Motion of spherical Shell and solid cylinder rolling down an inclined plane.

Unit-III

1. Gravitation: (9 Lectures)

Newton's Law of Gravitation, Motion of a particle in a central force field (motion in a plane, angular momentum is conserved, areal velocity is constant), Kepler's Laws (statement only),

Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness, Basic idea of global positioning system (GPS).

2. Oscillations: (6 Lectures)

Simple harmonic motion, Differential equation of SHM and its solutions, Kinetic and Potential Energy, Total Energy and their time averages, Damped oscillations, Forced oscillations. Frequency of nanoscale matters.

Unit-IV

1. Elasticity: (9 Lectures)

Bending of beam, Bending moment, Cantilever (without considering weight of cantilever), Beam supported at both the ends (without considering weight of beam).

Torsional oscillation, Work done in twisting a wire , Twisting couple on a cylinder - Torsional pendulum-Determination of Rigidity modulus and moment of inertia , Determination of Y, η and σ by Searles method. Elasticity of nanoscale matters.

2. Surface Tension: (6 Lectures)

Surface tension (definition), Angle of contact and wettability, Relation between surface tension, excess of pressure and radius of curvature, Experimental determination of surface tension by Jaeger's method, Applications of surface tension. Hydrophobic and superhydrophobic nanostructured surface.

Note: *Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.*

Reference Books:

1. University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. Addison-Wesley
2. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley eastern Ltd, New Delhi.
4. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
5. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
6. Physics – S.G. Starling and Woodal Longmams and Green Co. Ltd.
7. Elements of properties of matter – D.S. Mathur, Shamlal Charitable trust New Delhi.
8. A text Book of properties of matter–N.S. Khare and S. Kumar. Atmaram and sons New Delhi.
9. Concepts of Physics –Vol.1 H.C. Verma -Bharati Bhavan Publishers.

10. The big ideas of Nanoscale Science & Engineering- S. Stevens and M. Sutherland, CRC Press.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. –M.Sc. Part – I, Semester- I

Physics Laboratory – 1

DSC- 1A-Phys.-LAB: MECHANICS

(Theory: 60 Lectures)

1. Measurements of length (or diameter) using Vernier calliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Moment of inertia of a disc using auxiliary annular ring.
4. Young's modulus of material of Bar by vibration.
5. Modulus of rigidity of material of wire by torsional oscillations
6. Y/η of Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. Poission ratio for rubber using rubber tube.
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. College Practical Physics – Khanna and Gulati (S. Chand and Co. Ltd, Delhi).
5. Practical Physics – Gupta and Kumar (Pragati Prakation Meerat)
6. Advanced Level Practical Physics – J.M. Nelcon, J.M. Ogloom (EIBS).
7. A Text Book of Practical Physics - Shrinivasan and Balasubramanyam.
8. Engineering Practical Physics- S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. – M.Sc. Part – I, Semester- I

Chemistry-Paper- I

DSC- 2A-Chem.: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS
(Theory: 60 Lectures)

Unit I: **(14 Lectures)**

Atomic Structure:

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. Surface area of atoms and nanoscale materials.

What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of $\psi$and ψ^2, Schrödinger equation for hydrogen atom. Radialand angular parts of the hydogenic wavefunctions(atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3pand 3dorbitals (Only graphical representation). Radial and angular nodesand their significance. Radial distribution functions and the concept of the most probabledistance with special reference to 1sand 2satomic orbitals. Significance of quantumnumbers, orbital angular momentum and quantum numbers$m_l$andm_s. Shapes ofs, panddatomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spinquantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stabilityof half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Unit II: **(16Lectures)**

Chemical Bonding and Molecular Structure:

Ionic Bonding: General characteristics of ionic bonding.Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability.Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding:VB Approach: Shapes of some inorganic molecules and ions on the basisof VSEPR and hybridization with suitable examplesof linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding. MOs and theircharacteristics fors-s, s-pand p-pcombinations of atomic orbitals, nonbonding combinationof orbitals, MO treatment of homonucleardiatomic molecules of 1st and 2nd periods(including idea of s-pmixing) and heteronuclear diatomic molecules such as CO, NO andNO^+. Comparison of VB and MO approaches.

Nano Perspective of bondings: Bonding considerations at nanoscale.

Unit III:

Fundamentals of Organic Chemistry: (8 Lectures)

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry: (10 Lectures)

Conformations with respect to ethane, butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto twocarbon atoms). Configuration: Geometricaland Optical isomerism; Enantiomerism,Diastereomerism and Meso compounds).Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (forupto two C=C systems).

Unit IV: (12 Lectures)

Aliphatic Hydrocarbons:

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes:(Upto 5 Carbons).*Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe'ssynthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. Concept of Nanocatalysis.

Alkenes: (Upto 5 Carbons)*Preparation:*Elimination reactions: Dehydration of alkenes anddehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytichydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$)and trans-addition (bromine), Addition ofHX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Upto 5 Carbons) *Preparation:*Acetylene from $CaC_2$and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$,ozonolysis and oxidation with hot alk. $KMnO_4$.

Nanoscale carbon materials (carbonaceous materials-Bucky ball, graphene oxide, carbon nanotubes)

Reference Books:

1. Lee, J.D.Concise Inorganic ChemistryELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L.Basic Inorganic Chemistry, 3rd Ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in InorganicChemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry:Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E.Fundamentals of Organic Chemistry, 7thEd. Cengage Learning IndiaEdition, 2013.
7. Sykes, P.A Guidebook to Mechanism in Organic Chemistry, Orient Longman, NewDelhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
9. Finar, I.L.Organic Chemistry(Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
12. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

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B. Sc. –M.Sc. Part – I, Semester- I

Chemistry Laboratory – 1

DSC- 2A-Chem.-LAB: ATOMIC STRUCTURE, BONDING, GENERAL ORGANICCHEMISTRY & ALIPHATIC HYDROCARBONS

(Practical: 60 Lectures)

Section A: Inorganic Chemistry - Volumetric Analysis:

1. To prepare standard 0.1 N KMnO4 solution and to determine the strength of given oxalic acid solution.
2. To determine quantity of Fe(II)ions from the given solutions by titrating it with 0.1 N K_2Cr2O7 solution by using internal indicator
3. To estimate amount of Cu (II) ions by iodometric titration by using Na2S2O3 solution.
4. To standardize supplied EDTA solution by titrating with 0.01 M ZnSO4 solution and to estimate amount of calcium from given solution by using Erio-T as an indicator.
5. Quality control-To determines percentage purity of the given sample of soda ash $Na_2CO_3$by titrimetric method.
6. Estimation of amount of Acetic acid from the given vinegar sample by titrimetric method
7. Chromatography : Separation and identification of cations by Paper Chromatographic technique from the following mixtures :

a) $Ni^{2+} + Cu^{2+}$

b) $Ni^{2+} + Co^{2+}$

Section B: Organic Chemistry:

1. Estimation of aniline. (by bromination method)
2. Estimation of acetamide.
3. Estimation of Aspirin.
2. Organic Qualitative Analysis: Detection of physical constant, type, functional group, elements, and Confirmatory test.

Identification of Organic Compounds (at least eight) (four containing at least one extra element- N, S, Cl. Br, I)

a) Acids: Oxalic acid, Benzoic acid, cinnamic acid

b) Phenols: Beta-Naphthol, Resorcinol

c) Base: Aniline, p-Nitroaniline

d) Neutral: Acetone, Acetanilide, Chloroform, m-Dinitrobenzene, Thiourea, Bromobenzene

Reference Books:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.

2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.

3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

4. Mann, F.G. & Saunders, B.C. Practical Organic ChemistryOrient-Longman, 1960.

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Biotechnology-Paper- I

DSC- 3A-Biotech.:CELL BIOLOGY

Theory: 60 Lectures

Unit-I **(15 Lectures)**

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation. Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.Cellular Nanomachines and building blocks of life, Phospholipid membrane : Natural Biological Assembly at the Nano-Scale

Unit –II **(15Lectures)**

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.Biological Nano-Motors: Kinesin and Dynein. Ion Channels: Nano-Pores of High Specificity.

Unit-III **(15 Lectures)**

Lysosomes: Vacuoles and micro bodies: Structure and functions.

Ribosomes: Structures and function including role in protein synthesis.

Mitochondria: Structure and function, Genomes, biogenesis.

Chloroplasts: Structure and function, genomes, biogenesis.

Nucleus: Structure and function, chromosomes and their structure.

Nucleic Acids: The Genetic Information Media and a Templatefor Nanotechnological Applications

Unit-IV **(15 Lectures)**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extra cellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction. Amyloid Fibrils as Self-Assembled Nano-Scale Bio-Assemblies.

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.Basics of Stem cells, role of nanotechnology in stem cells.

SUGGESTED READING FOR CELL BIOLOGY

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. JohnWiley & Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8thedition.Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5thedition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7thedition. Pearson Benjamin Cummings Publishing, San Francisco.

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Biotechnology Laboratory – 1

DSC-3A-Biotech.-LAB: BIOTECHNOLOGY

(Theory: 60 Lectures)

PRACTICALS

1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure of any Prokaryotic and Eukaryotic cell.
6. Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, esophagus, stomach, pancreas, intestine, kidney, ovary, testes.
7. Cell division in onion root tip/ insect gonads.
8. Preparation of Nuclear, Mitochondrial & cytoplasmic fractions.

SUGGESTED READING FOR BIOTECHNOLOGY LAB 3A

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. JohnWiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition.Lippincott Williams and Wilkins, Philadelphia.

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B. Sc. – M.Sc. Part – I, Semester- I

Mathematics-Paper- I

DSC-4A-Maths.: DIFFERENTIAL CALCULUS

Theory: 60 Lectures

Unit-I

Limit and Continuity (ε and δ definition), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem. **(15 Lectures)**

Unit-II

Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series, Maclaurin's series of sin x, cos x, e^x , log(l+x), (l+x)m, Maxima and Minima, Indeterminate forms. **(15 Lectures)**

Unit-III

Partial differentiation, Euler's theorem on homogeneous functions.Applications to the partial derivatives. **(15 Lectures)**

Unit-IV

(A)Numerical Differentiation(i) Introduction, Definition(ii) Numerical differentiation using Newton's forward differenceinterpolation formula,(iii) Newton's backward difference interpolation formula,(iv) Sterling's Central difference interpolation formula ,(v) Newton's divided difference formula.

(B) Complex Numbers(i) Rectangular, polar and exponential forms of complexnumbers,(ii) De□Moivre's Theorem,(iii) Powers, roots and log of complex numbers **(15 Lectures)**

Books Recommended:

1. H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2. G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007.

3. Finite differences and Numerical Analysis, H.C. Saxena , S.Chand and Company.
4. Complex Numbers, Algebra and Geometry: G. V. Kumbhojkar and H. V. Kumbhojkar,
5. Jamnadas and Com. Bombay, 1982

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B. Sc. –M.Sc. Part – I, Semester- I

Mathematics Laboratory – 1

DSC-4A-Maths.-LAB: DIFFERENTIAL CALCULUS

Practical: 30 Lectures

1. Examples on Newtons forward difference formula
2. Examples on Newtons backward difference formula
3. Examples on Central Difference formula
4. Examples on Differentiation at non tabular values
5. Lagranges method for undetermined multipliers
6. Jacobian-I
7. Jacobian-II
8. Numerical Methods for solution of Linear equations; Gaussian elimination Method
9. Numerical Methods for solution of Linear equations; Gauss Jordan Method
10. Numerical Methods for solution of Linear equations; Gauss Seidel Method

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B. Sc. – M.Sc. Part – I, Semester- I

Electronics-Paper- I

DSC-5A-Electr.: NETWORK ANALYSIS AND ANALOG ELECTRONICS

Theory: 60 Lectures

Unit I: (14 Lectures)

Circuit Analysis: Concept of Voltage and Current Sources. Kirchhoff's Current Law,Kirchhoff's Voltage Law. Principal of Duality. Superposition Theorem. Thevenin's Theorem.Norton's Theorem. Reciprocity Theorem. Maximum Power Transfer Theorem. Two PortNetworks: h, y and z parameters and their conversion.

Unit II: (18 Lectures)

Junction Diode and its applications: PN junction diode (Ideal and practical)-constructions, Formation of Depletion Layer, Diode Equation and I-V characteristics.Idea of static and dynamic resistance, dc load line analysis, Quiescent (Q) point. Zenerdiode, Reverse saturation current, Zener and avalanche breakdown. Qualitative idea ofSchottky diode. Rectifiers- Half wave rectifier, Full wave rectifiers (center tapped andbridge), circuit diagrams, working and waveforms, ripple factor and efficiency. FilterShuntcapacitor filter, its role in power supply, output waveform, and working.Regulation- Line and load regulation, Zener diode as voltage regulator, and explanationfor load and line regulation.

Unit III: (5 Lectures)

Bipolar Junction Transistor: Theory and working of BJT, Characteristics of transistor in CE and CBconfigurations, Regions of operation (active, cut off and saturation), Current gains α andβ. Relations between α and β. dc load line and Q point.

(10 Lectures)

Amplifiers: Transistor biasing and Stabilization circuits- Fixed Bias and VoltageDivider Bias. Thermal runaway, stability and stability factor S. Transistor as a two portnetwork, h-parameter equivalent circuit. Small signal analysis of single stage CEamplifier. Input and Output impedance, Current and Voltage gains. Class A, B and CAmplifiers.

Unit IV: **(13 Lectures)**

Cascaded Amplifiers: Two stage RC Coupled Amplifier and its Frequency Response.Feedback in Amplifiers: Concept of feedback, negative and positive feedback,advantages of negative feedback (Qualitative only). Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations. Phase shift andColpitt's oscillator. Determination of Frequency and Condition of oscillation.

Unipolar Devices: JFET. Construction, working and I-V characteristics (output andtransfer), Pinchoff voltage. UJT, basic construction, working, equivalent circuit and I-V characteristics.

Reference Books:

• Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004)

• Electrical Circuits, M. Nahvi & J. Edminister, Schaum's Outline Series, TataMcGraw-Hill (2005)

• Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press

• Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.

• Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.

• Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, TataMcGraw Hill

• Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning

• Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn.,Oxford University Press.

• J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)

• J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, TataMcGraw Hill (1991)

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Electronics Laboratory – 1

DSC-5A-Electr.-LAB: NETWORK ANALYSIS AND ANALOG ELECTRONICS

Theory: 30 Lectures

AT LEAST 04 EXPERIMENTS FROM THE FOLLOWING BESIDES #1

1. To familiarize with basic electronic components (R, C, L, diodes, transistors),

digital Multimeter, Function Generator and Oscilloscope.

2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.

3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.

4. Verification of (a) Superposition Theorem and (b) Reciprocity Theorem.

5. Verification of the Maximum Power Transfer Theorem.

6. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.

7. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR).

8. Study the effect of (a) C- filter and (b) Zener regulator on the output of FWR.

9. Study of the I-V Characteristics of UJT and design relaxation oscillator..

10. Study of the output and transfer I-V characteristics of common source JFET.

11. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.

12. Design of a Single Stage CE amplifier of given gain.

13. Study of the RC Phase Shift Oscillator.

14. Study the Colpitt`s oscillator.

Reference Books:

• Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)

• Networks, Lines and Fields, J.D.Ryder, Prentice Hall of India.

• J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
• Allen Mottershead, Electronic Devices and Circuits, Goodyear Publishing Corporation.

SHIVAJI UNIVERSITY, KOLHAPUR

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B. Sc. – M.Sc. Part – I, Semester- II

Physics-Paper- II

DSC-1B-Phys.: ELECTRICITY AND MAGNETISM

(Theory: 60 Lectures)

Unit-I

Vector Analysis: (**15 Lectures)**

Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

Unit-II

Electrostatics: (15 Lectures)

Electrostatic Field, electric flux, Gauss's theorem of electrostatics, Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, Calculation of electric field from potential, Capacitance of an isolated spherical conductor, parallel plate, spherical and cylindrical condenser, Energy per unit volume in electrostatic field, Dielectric medium, Polarisation, Displacement vector, Gauss's theorem in dielectrics, Parallel plate capacitor completely filled with dielectric. Electrostatic at nanoscale.

Unit-III

1. A.C. Circuits: (7 Lectures)

Complex numbers and their application in solving a. c. series LCR circuit, complex impedance, Reactance, Admittance, and Susceptance, Resonance in LCR series circuit, Sharpness of resonance (qualitative treatment only), Q-factor (definition only) A.C. Bridge - Owen’s Bridge. Memristor circuits at nanoscale.

2. Magnetism: (8 Lectures)

Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current, Divergence and curl of magnetic field, Magnetic vector potential, Ampere's circuital law, Magnetic properties of materials: Magnetic intensity, magnetic induction,

permeability, magnetic susceptibility, Brief introduction of dia-, para- and ferro-magnetic materials. Introduction to spintronics.

Unit-IV

1. Electromagnetic Induction: (5 Lectures)

Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils, Energy stored in magnetic field.

2. Maxwell's equations and Electromagnetic wave propagation: (10 Lectures)

Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization. Introduction to nanoelectrodynamics.

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
6. Electricity and Magnetism – Khare and Shrivastav.
7. Foundations of Electromagnetic Theory – Rritz and Milford.
8. University Physics 9th edition – Young and Freedman.
9. Concepts of Physics Vol-2 H. C. Verma
10. The big ideas of Nanoscale Science & Engineering- S. Stevens and M. Sutherland, CRC Press.

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B. Sc. –M.Sc. Part – I, Semester- II

Physics Laboratory – 2

DSC-1B-Phys.-LAB.: ELECTRICITY AND MAGNETISM

Practical: 60 Lectures

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c)DC Current, and (d) checking electrical fuses.
2. Measurement of constants of B. G.
3. Determine a high resistance by Leakage Method.
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
6. Impedance of series LCR circuit.
7. To study the series LCR circuit and determine its (a) Resonant Frequency, (b)Quality Factor.
8. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
9. Frequency of A. C. mains by sonometer.
10. To verify the Thevenin's / Norton's theorem.

Reference Books:

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. College Practical Physics – Khanna and Gulati (S. Chand and Co. Ltd, Delhi).
5. Practical Physics – Gupta and Kumar (Pragati Prakation Meerat)
6. Advanced Level Practical Physics – J.M. Nelcon, J.M. Ogloom (EIBS).
7. A Text Book of Practical Physics - Shrinivasan and Balasubramanyam.

8. Engineering Practical Physics- S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.

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B. Sc. – M.Sc. Part – I, Semester- II

Chemistry-Paper- II

DSC-2B-Chem.: CHEMICAL ENERGETICS, EQUILIBRIA &FUNCTIONAL ORGANIC CHEMISTRY

Theory: 60 Lectures

Unit I

Chemical Energetics: (10 Lectures)

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state andstandard enthalpies of formations, integral and differential enthalpies of solution and dilution.Calculation of bond energy, bond dissociation energy and resonance energy fromthermochemical data.Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. Introduction to nanoscale thermodynamics.

Chemical Equilibrium: (8 Lectures)

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemicalequilibrium. Distinction betweenΔG and ΔG^{o}, Le Chatelier's principle. RelationshipsbetweenKp, KcandKxfor reactions involving ideal gases.

Unit II

Ionic Equilibria: (12 Lectures)

Strong, moderate and weak electrolytes, degreeof ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases,pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree ofhydrolysis

and pH for different salts. Buffer solutions. Solubility and solubility product ofsparingly soluble salts – applicationsof solubility product principle.

Unit III

Functional group approach for the following reactions (preparations & reactions) to bestudied in context to their structure.

Aromatic hydrocarbons **(8 Lectures)**

Preparation(Case benzene): from phenol, by decarboxylation, from acetylene, from benzenesulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation andsulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides **(8 Lectures)**

Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (S_N1, S_N2 and S_Ni)reactions.

*Preparation:*from alkenesandalcohols.

*Reactions:*hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson'sether synthesis: Elimination vs substitution.

Aryl Halides

Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer& Gattermann reactions.

Reactions (Chlorobenzene):Aromatic nucleophilic substitution (replacement by –OH group)and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3(or $NaNH_2/NH_3$).

Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and arylhalides.

Unit IV

Alcohols, Phenols and Ethers(Upto 5 Carbons) **(18 Lectures)**

Alcohols:*Preparation:*Preparation of 1^o, $2^o$and 3^oalcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

*Reactions:*With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$,

acidic dichromate, conc. HNO_3). Oppeneauer oxidationDiols:(Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.*Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction,Houben–Hoesch Condensation, Schotten – Baumann Reaction.

Ethers(aliphatic and aromatic): Cleavage of ethers with HI.Aldehydes and ketones (aliphatic and aromatic): (Formaldehye, acetaldehyde, acetone and benzaldehyde)

Preparation: from acid chlorides and from nitriles.

Reactions – Reaction with HCN, ROH, $NaHSO_3$,NH_2-G derivatives. Iodoform test. AldolCondensation, Cannizzaro's reaction, Wittigreaction, Benzoin condensation. Clemensenreduction and Wolff Kishner reduction.Meerwein-Pondorff Verley reduction.

Introduction to functionalization of nanomaterial.

Reference Books:

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A.Organic Chemistry,JohnWiley & Sons (2014).
2. McMurry, J.E. Fundamentals of Organic Chemistry, 7thEd. Cengage Learning IndiaEdition, 2013.
3. Sykes, P. A Guidebook to Mechanism in Organic Chemistry,Orient Longman, NewDelhi (1988).
4. Finar, I.L. Organic Chemistry(Vol. I & II), E.L.B.S.
5. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
6. Bahl, A. & Bahl, B.S.Advanced Organic Chemistry,S. Chand, 2010.
7. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
8. Castellan, G.W. Physical Chemistry 4thEd. Narosa (2004).
9. Kotz, J.C., Treichel, P.M. & Townsend, J.R.General ChemistryCengage LearningIndia Pvt. Ltd., New Delhi (2009).
10. Mahan, B.H.University Chemistry 3rdEd. Narosa (1998).
11. Petrucci, R.H.General Chemistry 5thEd. Macmillan Publishing Co.: New York (1985).
12. Introduction to Nanoscience and Nanotechnology, Gabor L. Hornyak, H.F. Tibbals, Joydeep Dutta, John J. Moore, CRC Press.

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Chemistry Laboratory – 2

DSC-2B-Chem.-LAB: CHEMICAL ENERGETICS, EQUILIBRIA &

FUNCTIONAL ORGANIC CHEMISTRY
(Practical: 60 Lectures)

Section A: Physical Chemistry

Thermochemistry

1. Determination of equivalent weight of Mg by Eudiometer.
2. Study of specific reaction rate of hydrolysis of methyl acetate in presence of HCl.
3. Determination of heat of ionization of weak acid by using polythene bottle.
4. Determination of heat capacity of calorimeter for different volumes.
5. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
6. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
7. Determination of enthalpy of hydration of copper sulphate.
8. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria

pH measurements

a)Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

b)Preparation of buffer solutions:

(i)Sodium acetate-acetic acid.

(ii)Ammonium chloride-ammonium hydroxide.

Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

1.Purification of organic compounds by crystallization (from water and alcohol) anddistillation.

2.Criteria of Purity: Determination of melting and boiling points.

3.Preparations: Mechanism ofvarious reactions involved to be discussed.

Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a)Bromination of Phenol/Aniline

(b)Benzoylation of amines/phenols

(c)Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

Reference Books

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G.,Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.

2. Mann, F.G. & Saunders, B.C. Practical Organic ChemistryOrient-Longman, 1960.

3. Khosla, B. D.; Garg, V. C. & Gulati, A.Senior Practical Physical Chemistry,R. Chand & Co.: New Delhi (2011).

4. Practical book of Physical Chemistry: Nadkarni, Kothari & Lawande.

5. Experimental Physical Chemistry: A. Findlay.

6. Systematic Experimental Physical Chemistry: S. W. Rajbhoj, Chondhekar. (Anjali Publication.)

7. Experiments in Physical Chemistry: R. C. Das and B. Behra. (Tata Mc Graw Hill)

8) Advanced Practical Physical Chemistry: J. B. Yadav (Goel Publishing House.)

9) Practical Physical Chemistry: B. D. Khosala. (R. Chand & Sons)

7) Experiments in Chemistry: D. V. Jahagirdar.

10) A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis: A.I. Vogel (Third Ed.) (ELBS)

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. – M.Sc. Part – I, Semester- II

Biotechnology-Paper- II

DSC-3B-Biotech.: MAMMALIAN PHYSIOLOGY

(Theory: 60 Lectures)

Unit-I

Digestion and Respiration: (**15 Lectures)**

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.Fate of nanoparticles in body. . Respirocytes; A Mechanical Artificial Red Cell: Exploratory Design in Medical Nanotechnology

Unit-II

Circulation: **(15 Lectures)**

Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood. Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat. Nanoparticles: Blood Components Interactions

Unit-III

Muscle physiology and osmoregulation: **(15 Lectures)**

Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation, Excretion and Toxicity of nanoparticles. Concept of tissue, Role of nanotechnology in tissue engineering.

Unit-IV

Nervous and endocrine coordination **(15 Lectures)**

Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids) Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.Nanotechnology in neuroscience, nanotube microelectrodes neurotransmitter measurements in the brain.

SUGGESTED READING FOR MAMMALIAN PHYSIOLOGY

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5thedition. ASMPress & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7thedition. Pearson Benjamin Cummings Publishing, San Francisco.

SHIVAJI UNIVERSITY, KOLHAPUR
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B. Sc. –M.Sc. Part – I, Semester- II

Biotechnology Laboratory – 2

DSC-3B-Biotech.-LAB: MAMMALIAN PHYSIOLOGY

Practicals: 60 Lectures

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Haemoglobin

SUGGESTED READING FOR BIOTECHNOLOGY LAB 3B

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. – M.Sc. Part – I, Semester- II

Mathematics-Paper- II

DSC-4B-Maths.: DIFFERENTIAL EQUATIONS

(Theory: 60 Lectures)

Unit I

First order exact differential equations. Integrating factors, rules to find an integrating factor. First order higher degree equations solvable for x, y, p. **(15 Lectures)**

Unit II

(A) Applications of differential equations:
Newton's law of Cooling, Kirchoff's law of electrical circuits, motion under gravity, simple harmonic motion.

(B) Numerical Solution of Ordinary Differential Equations of first order and first degree:
(i) Introduction, (ii) Solution by Picard's method, (iii) Taylor's series method, (iv) Euler's method, (v) Modified Euler's method, (vi) Runge-Kutta second and fourth order Method
(15 Lectures)

Unit III

Methods for solving higher-order differential equations.Basic theory of linear differential equations, Wronskian, and its properties.Solving a differential equation by reducing its order.Linear homogenous equations with constant coefficients, Linear non-homogenous equations. **(15 Lectures)**

Unit IV

The method of variation of parameters. The Cauchy-Euler equation, Simultaneous differential equations, Total differential equation.Order and degree of partial differential equations, Concept of linear and non-linear partial differential equations, Formation of first order partial differential equations. **(15 Lectures)**

Books Recommended:

1. Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.

2. I. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, International Edition.

3. Introductory Methods of Numerical Analysis, S.S. Sastry, 3rd edition, Prentice Hall of

India, 1999.

SHIVAJI UNIVERSITY, KOLHAPUR
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B. Sc. –M.Sc. Part – I, Semester- II

Mathematics Laboratory – 2

DSC-4B-Maths.-LAB: DIFFERENTIAL EQUATIONS

Practical: (30 Lectures)

1. Examples on PicardsMathod

2. Examples on EulersMathod

3. Examples on Eulers Modified Mathod

4. Examples on Taylors series method

5. Examples on Runge-Kutta Method

6. Applications of Differential equations: Orthogonal Trajectories

7. Examples on Newtons Law of cooling

8. Examples on Basic Electrical Circuits

9. Laplace Transform-I

10. Laplace Transform -II

11. Laplace Transform-III

12. Inverse Laplace Transform

13. Applications of Laplace Transform to solve Differential Equations

SHIVAJI UNIVERSITY, KOLHAPUR
School of Nanoscience and Technology(5 year integrated course)
B. Sc. – M.Sc. Part – I, Semester- II

Electronics-Paper- II

DSC-5B-Electr.: LINEAR AND DIGITAL INTEGRATEDCIRCUITS

(Theory: 60 Lectures)

Unit I (**17 Lectures**)

Operational Amplifiers (Black box approach): Characteristics of an Ideal andPractical Operational Amplifier (IC 741), Open and closed loop configuration,Frequency Response. CMRR. Slew Rate and concept of Virtual Ground.

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Summingand Difference Amplifier, (3) Differentiator, (4) Integrator, (5) Wein bridge oscillator,(6) Comparator and Zero-crossing detector, and (7) Active low pass and high passButterworth filter (1st order only). (**12 Lectures**)

Unit II (**13 Lectures**)

Number System and Codes: Decimal, Binary, Octal and Hexadecimal number systems,base conversions. Representation of signed and unsigned numbers, BCD code. Binary,octal and hexadecimal arithmetic; addition, subtraction by 2's complement method,multiplication. (**9 Lectures**)

Logic Gates and Boolean algebra: Truth Tables of OR, AND, NOT, NOR, NAND,XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Booleanalgebra. (**4 Lectures**)

Unit III (**11 Lectures**)

Combinational Logic Analysis and Design: Standard representation of logic functions(SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4variables for SOP). (**5 Lectures**)

Arithmetic Circuits: Binary Addition. Half and Full Adder. Half and Full Subtractor, 4-bit binary Adder/Subtractor. (**3 Lectures**)

Data processing circuits: Multiplexers, De-multiplexers, Decoders, Encoders.(**3 Lectures**)

Unit IV (**19 Lectures**)

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered)Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop.Master-slave JK Flip-Flop. (**9 Lectures**)

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out andParallel-in-Parallel-out Shift Registers (only up to 4 bits). (2 **Lectures**)

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter.Synchronous Counter. (**4 Lectures**)

D-A and A-D Conversion: 4 bit binary weighted and R-2R D-A converters, circuit andworking. Accuracy and Resolution. A-D conversion characteristics, successiveapproximation ADC. (Mention of relevant ICs for all). (**4 Lectures**)

Reference Books:

- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, OxfordUniversity Press.
- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011,Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
- Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

SHIVAJI UNIVERSITY, KOLHAPUR
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B. Sc. –M.Sc. Part – I, Semester- II

Electronics Laboratory – 2

DSC-5B-Electr.-LAB: LINEAR AND DIGITAL INTEGRATEDCIRCUITS

Practical: (30 Lectures)

Any SIX Experiments

1. To design an inverting amplifier using Op-amp (741,351)for dc voltage of given gain

2. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response
(b) To design non-inverting amplifier using Op-amp (741,351) & study frequency response

3. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode
(b) To study the zero-crossing detector and comparator.

4. To investigate the use of an op-amp as an Integrator.

5. To investigate the use of an op-amp as a Differentiator.

6. To design a Wien bridge oscillator for given frequency using an op-amp.

7. (a) To design a combinational logic system for a specified Truth Table.
(b) To convert Boolean expression into logic circuit & design it using logic gate ICs.
(c) To minimize a given logic circuit.

8. Half Adder and Full Adder.

9. Half Subtractor and Full Subtractor.

10. 4 bit binary adder and adder-subtractor using Full adder IC.

11. To design an Astable Multivibrator of given specification using IC 555 Timer.

12. To design a Monostable Multivibrator of given specification using IC 555 Timer.

13. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.

14. To build JK Master-slave flip-flop using Flip-Flop ICs

15. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.

NATURE OF QUESTION PAPER
CBCS B. Sc. –M. Sc. Nanoscience and Technology (5 year integrated course)/B. Sc. Nanoscience and Technology/ M. Sc. Nanoscience and technology
SCHOOL OF NANOSCIENCE AND TECHNOLOGY

All Questions are compulsory

Time duration (3 hours) **Total Marks: 80**

Q. 1.Select the correct answers: MCQ **1 x 8 = 8**

i) ii)

iii) iv)

v) vi)

vii) viii)

Q. 2. Write short notes on: **2 x 4 = 8**

a) b)

c) d)

Q. 3. Answer any six of the following: **4 x 6 = 24**

a)

b)

c)

d)

e)

f)

g)

h)

Q.4. Answer any five of the following: **8 x 5 = 40**

a)
b)

c)
d)
e)
f)

NATURE OF QUESTION PAPER

CBCS B. Sc. –M. Sc. Nanoscience and Technology (5 year integrated course)/B. Sc. Nanoscience and Technology/ M. Sc. Nanoscience and technology

SCHOOL OF NANOSCIENCE AND TECHNOLOGY

All Questions are compulsory

Time duration (3 hours) **Total Marks: 40**

Q. 1.Select the correct answers: MCQ **1 x 4 = 4**

i) ii)

iii) iv)

Q. 2. Write short notes on: **2 x 2 = 4**

a) b)

Q. 3. Answer any two of the following: **4 x 2 = 8**

a)

b)

c)

Q.4. Answer any three of the following: **8 x 3 = 24**

a)
b)
c)
d)