Shiksha Mandal's

JANKIDEVI BAJAJ COLLEGE OF SCIENCE, WARDHA

(An Autonomous college - Affiliated to RTM Nagpur University)

DIRECTION RELATING TO THE EXAMINATION LEADING TO THE DEGREE OF MASTER OF SCIENCE, SEMESTER PATTERN (CBCS-CHOICE BASED CREDIT SYSTEM)
SESSION: 2017-18

1. The duration of the M. Sc. course shall be of two academic years consisting of four semesters with the University examinations at the end of each semester namely:
    a) M. Sc. Semester I Exam
    b) M. Sc. Semester II Exam
    c) M. Sc. Semester III Exam
    d) M. Sc. Semester IV Exam
2. The theory examination of Semester-I, II, III, IV shall be held as per the schedule given in Table below:

Sr. No.	Name of the examination	Main Examination	Supplementary Examination
1	Semester I, Semester III	Winter	Summer
2	Semester II, Semester IV	Summer	Winter

ELIGIBILITY TO THE COURSE:

3. The following applicant candidates shall be eligible for the admission to Master of Science and examinations

A	For M.Sc. (Chemistry) Semester-I	For admission to the M. Sc. Semester I in Chemistry, a candidate shall have offered Chemistry / Industrial Chemistry as one of the subjects at the qualifying B.Sc. Examination.
B	For M.Sc. (Botany) Semester-I	For admission to the M. Sc. Semester I in Botany, a candidate shall have offered Botany as one of the subjects at the qualifying B.Sc. Examination / B.Sc. (Agriculture) with Botany is one of the subject.
C	For M.Sc. (Zoology) Semester-I	For admission to the M. Sc. Semester I in Zoology, a candidate shall have offered Zoology as one of the subjects at the qualifying B.Sc. Examination.
D	For M.Sc. (Microbiology) Semester-I	For admission to the M. Sc. Semester I in Microbiology, a candidate shall have offered Microbiology / Biotechnology as a subject of study and examination at B.Sc. degree.
E	For M.Sc. (Biotechnology) Semester-I	For admission to the M. Sc. Semester I in Biotechnology, a candidate shall have offered Chemistry and Biotechnology as subjects of study and examination at B.Sc. degree.

Candidates shall have passed any one of the above examinations from Rashtrasant Tukadoji Maharaj Nagpur University or any other statutory University of India or abroad, recognized by the UGC or any other concerned apex regulatory authority / body of India.

4. Semester Examinations

A	M. Sc. Semester I Examination	Students who have fulfilled the eligibility criteria as mentioned in Section 3 and have been admitted to this course in Semester I.
B	M. Sc. Semester II Examination	Students who have been admitted to this course in semester II.
C	M. Sc. Semester III Examination	Students who have been admitted to this course in semester III.
D	M. Sc. Semester IV	Students who have been admitted to this course in semester IV. Every student shall submit two copies of the project report (typed

		and properly bound) for the Fourth Semester to the Concerned. Department at least one month prior to the commencement of the final practical examination through the Head of the Department. Along with the certificate signed by the supervisor and declaration by the candidate towards original work which is not submitted to any university or organization for award of the degree. The scheme/guidelines for the students and supervisors regarding Project Work Report are given in Appendix 04

Note: Subject to the Rules of ATKT as mentioned in para 5 of this direction)

5. The ATKT rules for admission for the M. Sc. Course (Theory, Practical and Seminar as separate passing head) shall be as given in the following table

Admission to Semester	Candidate should have passed in all the subjects of the following examination of J.B. College of Science.	Candidate should have passed at least two third of the passing heads of the following examinations
Semester I	As provided in the para 3 of the direction	--------
Semester II	--------	--------
Semester III	--------	Semester I and II taken together
Semester IV	--------	--------

6. The medium of instruction and examination shall be English.
7. The number of papers and maximum marks assigned to each paper and minimum marks / grade, an examinee must obtain in order to pass the examination shall be as prescribed in appendices appended with this direction.
8. The examinee at each of the examination shall have option of not being declared successful at the examination in case he / she does not secure a minimum of grade equivalent to 55% marks at the examination. This option will have to be exercised every time the application is submitted to any of the examinations. Once this option is exercised, the option shall be binding on the examinee and it shall not be evoked in under any circumstances.
9. The classification of the examinee successful at the semester and examinations and at the end of final semester examination shall be as per the rules and regulations of Choice Based Credit System as prescribed in appendices, appended with this direction.
10. Successful examinees at the end of M. Sc. Sem-IV Examination who obtained CGPA above 7.51 shall be placed in First Division with distinction, those obtaining CGPA from 6.00 to 7.50 shall be placed in First Division, those obtaining CGPA from 4.50 to 5.99 shall be placed in Second Division and those obtaining CGPA from 4.00 to 4.49 shall be placed in Third Division.
11. No candidate shall be admitted to an examination under this direction, if he / she have already passed the same examination of this college or of any other university.

Appendix-1

Scheme of teaching and examination under semester pattern Choice Based Credit System (CBCS) for M.Sc.-Zoology Program

Semester I for M.Sc.-Zoology Program											
Code	Theory /**Practical**	Teaching scheme (Hours/ Week)			Credits	Examination Scheme					
						Duration in hrs	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory/Lecture	**Practical**	**Total**			External Marks	Internal Asse.		Theory	**Practical**
Core 1	Paper 1	4	--	4	4	3	80	20	100	40	--
Core 2	Paper 2	4	--	4	4	3	80	20	100	40	--
Core 3	Paper 3	4	--	4	4	3	80	20	100	40	--
Core 4	Paper 4	4	--	4	4	3	80	20	100	40	--
Pract. Core 1 and 2	Practical 1	--	8	8	4	3-8*	100**	--	100	--	40
Pract. Core 3 and 4	Practical 2	--	8	8	4	3-8*	100**	--	100	--	40
Seminar 1	Seminar 1	2	--	2	1	--	--	25	25	10	--
	Total	**18**	**16**	**34**	**25**	**--**	**520**	**105**	**625**	**170**	**80**

Semester II for M.Sc.-Zoology Program											
Code	Theory /**Practical**	Teaching scheme (Hours/ Week)			Credits	Examination Scheme					
						Duration in hrs	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	**Practical**	**Total**			External Marks	Internal Asse.		Theory	**Practical**
Core 5	Paper 5	4	--	4	4	3	80	20	100	40	--
Core 6	Paper 6	4	--	4	4	3	80	20	100	40	--
Core 7	Paper 7	4	--	4	4	3	80	20	100	40	--
Core 8	Paper 8	4	--	4	4	3	80	20	100	40	--
Pract. Core 5 and 6	Practical 3	--	8	8	4	3-8*	100**	--	100	--	40
Pract. Core 7 and 8	Practical 4	--	8	8	4	3-8*	100**	--	100	--	40

Seminar 2	Seminar 2	2	--	2	1	--	--	25	25	10	--
	Total	**18**	**16**	**34**	**25**	**--**	**520**	**105**	**625**	**170**	**80**

Semester III for M.Sc.-Zoology Program											
Code	Theory /**Practical**	Teaching scheme (Hours/ Week)			Credits	Examination Scheme					
						Duration in hrs	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	**Practical**	**Total**			External Marks	Internal Asse.		Theory	**Practical**
Core 9	Paper 9	4	--	4	4	3	80	20	100	40	--
Core 10	Paper 10	4	--	4	4	3	80	20	100	40	--
Core Elective 1	Paper 11	4	--	4	4	3	80	20	100	40	--
Foundation Course 1/Core (Subject Centric) 1	Paper 12	4	--	4	4	3	80	20	100	40	--
Pract. Core 9 and 10	Practical 5	--	8	8	4	3-8*	100 **	--	100	--	40
Pract. Core Elective 1	Practical 6	--	8	8	4	3-8*	100 **	--	100	--	40
Seminar 3	Seminar 3	2	--	2	1	--	--	25	25	10	--
	Total	**18**	**16**	**34**	**25**	**--**	**520**	**105**	**625**	**170**	**80**

Semester IV for M.Sc.-Zoology Program											
Code	Theory /**Practical**	Teaching scheme (Hours/ Week)			Credits	Examination Scheme					
						Duration in hrs	Max. Marks		Total Marks	Minimum Passing Marks	
		Theory	**Practical**	**Total**			External Marks	Internal Asse.		Theory	**Practical**
Core 11	Paper 13	4	--	4	4	3	80	20	100	40	--

Core 12	Paper 14	4	--	4	4	3	80	20	100	40	--
Core Elective 2	Paper 15	4	--	4	4	3	80	20	100	40	--
Foundation Course 2/Core (Subject Centric) 2	Paper 16	4	--	4	4	3	80	20	100	40	--
Pract. Core 11, 12 & Elective 2	Practical 7	--	8	8	4	3-8*	100 **	--	100	--	40
Project	Project	--	8	8	4	--	100 **	--	100	--	40
Seminar 4	Seminar 4	2	--	2	1	--	--	25	25	10	--
	Total	**18**	**16**	**34**	**25**	**--**	**520**	**105**	**625**	**170**	**80**

Note: * = If required, for two days; ** = The Practical and Project shall be evaluated by both the External and Internal Examiner in the respective Department as per guidelines appended with this direction.

Details of course code and names of Theory paper for M.Sc.-Zoology Program

Semester	Code	Paper	Name of Paper
Semester-I	Core 1	Paper 1	Structure and Function of Invertebrates
	Core 2	Paper 2	General Physiology
	Core 3	Paper 3	Cell Biology and Genetics
	Core 4	Paper 4	Advanced Reproductive Biology
Semester-II	Core 5	Paper 5	Structure and Function of Vertebrates
	Core 6	Paper 6	Comparative Endocrinology
	Core 7	Paper 7	Molecular Biology and Biotechnology
	Core 8	Paper 8	Advanced Developmental Biology
Semester-III	Core 9	Paper 9	Parasitology and Immunology
	Core 10	Paper 10	Animal Physiology / Cell Biology
	Core Elective I	Paper 11	Animal Physiology / Cell Biology
	Core (Subject Centric) I	Paper 12	Wildlife and Avian Biology
Semester-IV	Core 11	Paper 13	Biotechnique, Biostatics, Ethology, Toxicology and Bioinformatics
	Core 12	Paper 14	Animal Physiology / Cell Biology
	Core Elective II	Paper 15	Animal Physiology / Cell Biology
	Core (Subject Centric) II	Paper 16	Radiation and Chronobiology

For details on,

1. Project: Refer Appendix 2
2. Seminar: Refer Appendix 3
3. Internal Assessment Marks: Refer Appendix 4
4. Practical Examination: Refer Appendix 5
5. Core Elective Papers: Refer Appendix 6
6. Foundation Course/Core (Subject Centric): Refer Appendix 7

7. Rules and Regulation regarding pattern of question paper, absorption scheme and CBCS pattern: Refer Appendix 8

Appendix-2

Project Work Scheme:

Guidelines for the Students, Supervisors and Examiners

Every student is required to carry out a project work in semester IV. The student will have to carry out the project work (based on guidelines given in this direction) in lieu of practical in the fourth semester in the department or depending on the availability of placement; he/she will be attached to any of the national /regional/private research institute/organization. The project can be of following types. A) Experimental Project Work; OR B) Field Based Project Work; OR C) Review writing based Project Work.

Experimental Project Work and Field Based Project Work

Student can carry out Experimental / Field Based Project Work on a related research topic of the subject /course. It must be an original work and must indicate some degree of experimental work / Field work. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV or VI as applicable. The project report shall comprise of Introduction, Material and Methods, Results, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator.

Review writing based Project Work

Student can carry out review writing Based Project Work on a related topic of the subject / course. It must be a review of topic based on research publications. Student shall refer peer reviewed original research publications and based on findings, write a summary of the same. The pattern of review writing shall be based on reputed reviews published in a standard, peer reviewed journals. On the basis of this work, student must submit the Project Report (typed and properly bound) in two copies at least one month prior to commencement of the final Practical / lab Examination of Semester IV as applicable. The project report shall comprise of Abstract, Introduction, detailed review, Discussion, Summary, Conclusion and, References along with the declaration by the candidate that the work is original and not submitted to any University or Organization for award of the degree and certificate by the supervisor and forwarded through Head / Course-coordinator

- The supervisors for the Project Work shall be from the following.
  A person shall be an approved faculty member in the relevant subject OR
  Scientists of National Laboratories/Regional Research Laboratories/Nagpur University/Other Universities recognized by UGC.
- The Project Work will carry total 100 marks and will be evaluated by both external and internal examiner in the respective Department.
- The examiners will evaluate the Experimental Project Work taking into account the Coverage of subject matter, Arrangement and presentation, References etc.

For written Project work	: 40 Marks – Evaluated jointly by External & Internal
Presentation	: 20 Marks – Evaluated jointly by External & Internal
For Viva-Voce	: 20 Marks – Evaluated by External examiner
Internal Assessment	: 20 Marks – Evaluated by Internal examiner
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Total	: 100 Marks

Appendix-3

Seminar:

Guidelines for Students, Supervisors and Examiners

1. In each semester, the student will have to deliver a seminar on any topic relevant to the syllabus / subject encompassing the recent trends and development in that field / subject. The topic of the seminar will be decided at the beginning of each semester in consultation with the supervising teachers. The student has to deliver the seminar which will be followed by discussion. The seminar will be open to all the teachers of the department, invitees, and students.
2. The students should submit the seminar report typed and properly bound in two copies to the head of the department. The said shall be evaluated by the concerned supervisor / head of the department. The record of the seminar should be preserved till the declaration of the final result.

Appendix-4

Internal Assessment:

For the purpose of internal assessment the College shall conduct one to three assignments described below. Best two scores of a student in these tests shall be considered to obtain the internal assessment score of that student.
General guidelines for Internal Assessment are:

a) The internal assessment marks assigned to each theory paper as mentioned in Appendix-1 shall be awarded on the basis of assignments like class test, attendance, home assignments, study tour, expedition, visit to educational institutions and research organizations, field work, group discussions or any other innovative practice/activity.
b) There shall be one to three assignments (as described above) per theory paper.
c) There shall be no separate/extra allotment of work load to the teacher concerned. He/she shall conduct the internal assessment activity during the regular teaching days/periods as a part of regular teaching activity.
d) The concerned teacher/department /college shall have to keep the record of all the above activities.
e) At the beginning of each semester, every teacher/department /college shall inform his/her students unambiguously the method he/she propose to adopt and the scheme of marking for internal assessment.
f) Teacher shall announce the schedule of activity for internal assessment in advance in consultation with HOD/Principal.

Appendix-5

Practical Examination:

1. Each practical carries 100 marks. For the examination, the distribution of the marks shall be as follows:
   a. Record / Journal / Internal assessment : 20 marks – Evaluated by Internal
   b. Practical Performance : 60 marks – Evaluated jointly by External & Internal
   c. Viva-voce : 20 marks - Evaluated by External

   NOTE: Practical performance shall be jointly evaluated by the External and Internal Examiner. In case of discrepancy, the External Examiner's decision shall be final.
2. Practical exam shall be of 3 to 8 hours duration for one or two days, depending on subject and number of students.
3. The Practical Record of every student shall carry a certificate as shown below, duly signed by the teacher-in-charge and the Head of the Department.
4. If the student fails to submit his/her certified Practical Record duly signed by the Teacher-In-Charge and the Head of the Department, he/she shall not be allowed to appear for the Practical Examination and no Marks shall be allotted to the student.
5. The certificate template shall be as follows:

C E R T I F I C A T E

Name of the college / institution _
Name of the Department: _

This is to certify that this Practical Record contains the bonafide record of the Practical work of Shri / Shrimati / Kumari _ of M. Sc. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ Semester _ _ _ _ _ _ _ _ _ _ during the academic year _ _ _ _ _ _ _. The candidate has satisfactorily completed the experiments prescribed by JANKIDEVI BAJAJ COLLEGE OF SCIENCE, WARDHA (An Autonomous college - Affiliated to RTM Nagpur University) for the subject _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Dated _ _ _ / _ _ _ / _ _ _ _ _

Signature of the teacher who taught the examinee
1. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
2. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Head of the Department

Appendix-6

Subject wise Core Elective Papers:

M. Sc. Subject	Core elective paper to be opted in Semester III	Core elective paper to be opted in Semester IV
M. Sc. (Chemistry)	Environmental Chemistry I	Environmental Chemistry II
	Instrumental Techniques in Chemistry I	Instrumental Techniques in Chemistry II

M. Sc. (Botany)	Molecular Biology and Plant Biotechnology I	Molecular Biology and Plant Biotechnology II
	Reproductive Biology of Angiosperms I	Reproductive Biology of Angiosperms II
	Advanced Phycology and Hydrobiology I	Advanced Phycology and Hydrobiology II
	Mycology and Plant Pathology I	Mycology and Plant Pathology II
	Palaeobotany I	Palaeobotany II
	Palynology I	Palynology II
	Plant Physiology I	Plant Physiology II
M. Sc. (Zoology)	**Animal Physiology II**	**Animal Physiology IV**
	Cell Biology II	**Cell Biology IV**
M. Sc. (Microbiology)	Microbial Diversity, Evolution and Ecology (MDEE) I	Microbial Diversity, Evolution and Ecology (MDEE) II
	Bioinformatics (BIF) I	Bioinformatics (BIF) II
M. Sc. (Biotechnology)	Industrial Biotechnology I	Industrial Biotechnology II
	Environmental Biotechnology I	Environmental Biotechnology II

Note: Student can choose Core Elective Paper from the above list at the beginning of Semester III. Once the choice between Core Elective Paper is made by the candidate at the beginning of Semester III, it cannot be changed in Semester IV.

Appendix-7

Foundation Course/Core (Subject Centric) Paper:
Student can choose either Foundation course paper or Core (Subject Centric) paper at the beginning of Semester III. Once the choice between Foundation Course/Core (Subject Centric) is made by the candidate at the beginning of Semester III, it cannot be changed in Semester IV.

Part A:
Foundation Course: Candidate can opt for any one foundation course paper as shown below in the semester III and IV. However, Student shall opt for this paper from any other subject other than his/her main subject for post-graduation (e.g. A candidate pursuing M. Sc. Chemistry can opt for foundation course papers mentioned in other M. Sc. subjects except papers mentioned under M. Sc. Chemistry). If the candidate decides to opt for foundation course papers then he/she shall not be eligible to opt for Core (Subject Centric) papers in their respective subjects.

List of foundation courses available:

M. Sc. Subject	**Foundation Course I in semester III**	**Foundation Course II in Semester IV**
M. Sc. (Chemistry)	Medicinal Chemistry I	Medicinal Chemistry II
M. Sc. (Botany)	General Botany	Applied Botany
M.Sc. (Zoology)	**Human Physiology**	**Applied Human Physiology**
M. Sc. (Microbiology)	General Microbiology	Advanced Microbiology
M. Sc. (Biotechnology)	Introductory Biotechnology	Molecular Biotechnology

Part B:
Core (Subject Centric): Candidate can opt for this paper as shown below in the semester III and IV in their main subject of postgraduation only (e.g. A candidate pursuing M. Sc. Zoology can opt for Core (Subject Centric) papers from M. Sc. Zoology ONLY). If the candidate decides to opt for Core (Subject Centric) papers in their main subject of postgraduation then he/she shall not be eligible to opt for foundation course papers neither in their own subject nor in any other subject.

List of Core (Subject Centric) course available in the respective subject:

M. Sc. Subject	**Core (Subject Centric) I in semester III**	**Core (Subject Centric) II in semester IV**
M. Sc. (Chemistry)	Spectroscopy I	Spectroscopy II
M. Sc. (Botany)	Aesthetic Botany	Plant Resources
M. Sc. (Zoology)	**Wild Life & Avian Biology**	**Radiation & Chronobiology**
M. Sc. (Microbiology)	Drugs & Disease Management (DDM)	Vaccines & Delivery Systems
M. Sc. (Biotechnology)	Diagnostic Medical Biotechnology	Therapeutic Medical Biotechnology

Appendix-8

General Rules and Regulations regarding pattern of question paper, absorption scheme and choice based credit system:

A) Pattern of Question Paper

1. There will be four units in each paper.
2. Maximum marks of each theory paper will be 80
3. Question paper will consist of five questions, each of 16 marks.
4. Four questions will be on four units with internal choice (One question on each unit).
5. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

B) Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

M. Sc. Program shall consist of four semesters, wherein the student has to complete 100 credits. Each subject (or course) has fixed number of credits. The types of subject subheads are: Core, Core Practical, Core (Subject Centric), Core Elective, Core Elective Practical, Foundation Course, Seminar and Project/Review writing.

Explanatory terms:

1. **Core:** Major theory papers in the concerned subject.
2. **Core Elective:** These papers will be specialization in the concerned subject. Ex. Zoology – MRP, AP, Fisheries, Entomology etc.
3. **Foundation Course/Core (Subject Centric):** For details, refer Appendix 7.
4. **Project/Review writing:** Project / Review writing is in semester IV.
5. **Seminar:** The seminar in each semester shall be presented by the candidate in his/her parent department only.

Credits:

It is a unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture) or two hours of practical work / field work or two hours of seminar per week.

For example a subject with 4-8 (L- P) means it has 4 Lectures, 8 Practical in a week. This subject will have eight credits (4x1 + 8x½ = 8). If a student is declared pass in a subject, then he/she gets the credits associated with that subject. Depending on the marks scored in a subject, student is given a Grade. Each grade has got certain grade points as follows:

Letter Grade	O	A+	A	B+	B	C	P	F	Ab
Grade Point	10	09	08	07	06	05	04	0	0

A student obtaining Grade F shall be considered failed and will be required to reappear for the examination.

Valuation pattern:

Every credit is for 25 marks and valuation and grade points will be given as per following pattern.

Marks obtained In Theory/Practical (Out of 100 marks)	Marks obtained In Theory/Practical (Out of 50 marks)	Marks obtained In Theory/Practical (Out of 25 marks)	Letter Grade	Grade point
91-100	46-50	23-25	O	10
81-90	41-45	20-22	A+	09
71-80	36-40	18-19	A	08
61-70	31-35	15-17	B+	07
51-60	26-30	13-14	B	06
41-50	21-25	11-12	C	05
= 40	=20	=10	P	04
<40	<20	<10	F	0
Ab	Ab	Ab	Ab	0

Computation of SGPA and CGPA:

Following shall be the procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

1. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

SGPA (Si) = Σ(Ci x Gi) / Σ Ci

where Ci is the number of credits of the i^{th} course and
Gi is the grade point scored by the student in the i^{th} course.

Illustration for SGPA:

e.g. If student obtained following marks in Semester-I, then his/her SGPA shall be obtained as illustrated in below table

Code	Theory / Practical	Credits	Marks Obtained	Out of	Grade Point	Grade Letter	Credit Point (Credit x Grade Point)
Core 1	Paper 1	4	91	100	10	O	4x10=40
Core 2	Paper 2	4	89	100	9	A+	4x9=36
Core 3	Paper 3	4	50	100	5	C	4x5=20
Core 4	Paper 4	4	78	100	8	A	4x8=32
Pract. Core 1 & 2	Practical 1	4	89	100	9	A+	4x9=36
Pract. Core 3 & 4	Practical 2	4	85	100	9	A+	4x9=36
Seminar 1	Seminar 1	1	23	25	10	O	1x10=10
	Total	**25**					**210**
Thus, **SGPA =210/25 = 8.4**							

2. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.
   CGPA = Σ (Ci x Si) / Σ Ci
   where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

Illustration for CGPA

e.g. If student scored following SGPA in each semester, then his/her CGPA shall be obtained as illustrated in below table

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 25 SGPA: 8.46	Credit : 25 SGPA: 7.83	Credit : 25 SGPA: 5.69	Credit : 25 SGPA: 6.31

Thus,

CGPA = $\frac{25 \times 8.46 + 25 \times 7.83 + 25 \times 5.69 + 25 \times 6.31}{100}$

$= \frac{211.5 + 195.75 + 142.45 + 157.75}{100} = \frac{707.25}{100}$ **= 7.0725** **i.e. 7.07**

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
e. g.7.0765 = 7.08 or 7.0755 = 7.07 or 6.5168 = 6.52 etc.
Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the institute may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Jankidevi Bajaj College of Science, Wardha

(An Autonomous College)

Department of Zoology

Syllabus for M.Sc. Zoology (Semester Pattern)

Semester – I

Choice Based Credit System

With effect from Academic Year 2017-18

Semester-I

Paper-I, Structure and function of Invertebrates

Unit-I

1.1 Classical and molecular taxonomic parameters, species concept, systematic gradation of animals, nomenclature, modern scheme of animal classification into sub-kingdom, division, section, phyla and minor phyla.

1.2 Ultrastructure of protozoan locomotory organs (pseudopodia-cytoplasmic organells, flagella, cilia and pellicular myonemes) and mechanism of various modes of locomotion.

1.3 Dermal cells and skeletal organization in calcareous sponges, Hexactinilida and Demospongiae (Porifera).

1.4 Polymorphism and metagenesis in coelenterate. Types of polyps, medusa and metamorphosis.

Unit-II

2.1 Origin of metazoan-colonial, syncytial and molecular theories.

2.2 Reproductive system-structure and mechanism of reproduction in *Dugesia*, *Fasciola*, *Taenia* and *Ascaris*.

2.3 Formation, Evolution and significance of coelom, metamerism and symmetry in classification of animals, particularly coelomata.

2.4 Evolution of nephridia and mechanism of excretion (nitrogenous excretory products, transport of water and salts) in Polychaeta, Oligochaeta and Hirudinea of Annelida.

Unit-III

3.1 *Peripatus* (Onychophora) structure, affinities and taxonomic position.

3.2 Respiratory organs in Arthropoda. Mechanism of gaseous exchange in tracheal respiration in Insecta and gill respiration in Crustacea.

3.3 *Neopilina* (Monoplacophora): structure, affinities and taxonomic position.

3.4 Neuroanatomy in Gastropoda, Bivalvia and Cephalopoda.

Unit-IV

4.1 Water vascular system in Echinodermata: structure and functions.

4.2 Larval forms in Echinodermata: Metamorphosis and phylogenetic significance.

4.3 General account and affinities of Ctenophora and Rotifera.

4.4 General account and affinities of Entoprocta and Ectoprocta.

Jankidevi Bajaj College of Science, Wardha
(An Autonomous College)
Department of Zoology
Syllabus for M.Sc. Zoology (Semester Pattern)
Semester – I
Choice Based Credit System
With effect from Academic Year 2017-18

Semester-I

Paper-II, General Physiology

Unit-I

1.1 Enzyme: Classification, mechanism of enzyme action. Factors affecting enzyme action, regulation of enzyme activity, activators and inhibitors.
1.2 Respiratory pigments- types, distribution and properties, structure of haemoglobin and mechanism of O2 transport.
1.3 Neurotransmitters: chemical nature, biosynthesis and mechanism of synaptic transmission.
1.4 Colour change mechanism: Chromatophores and melanophores- structure, physiology and significance.

Unit-II

2.1 Bioluminescence: light producing organs- distribution in invertebrates and vertebrates, physiology and significance.
2.2 Thermoregulation in poikilotherms and homeotherms, adaptations and regulatory mechanisms.
2.3 Osmoregulation in Pisces and Amphibia, mechanism of salt and water transport by gills and kidney.
2.4 Molecular mechanism of peptide and steroid hormonal action. Membrane receptors and signal transduction.

Unit-III

3.1 Myogenic and neurogenic heart, Cardiac cycle- Phases of cardiac cycle, ECG pace maker, and heart valves.
3.2 Digestion and absorption of carbohydrate, proteins and lipids in the gastrointestinal tract.
3.3 Carbohydrates- classification and metabolism- glycogenesis, glycogenolysis, glycolysis, TCA cycle, electron transport system and oxidative phosphorylation.
3.4 Lipids- classification and metabolism- oxidation of fatty acids, cholesterol metabolism. Proteins- classification and metabolism- oxidative deamination, decarboxylation and trans amination of amino acids, arginine-ornithin cycle.

Unit-IV

4.1 Hydromineral metabolism-water electrolyte balance, mineral metabolism in bone and egg shell formation.
4.2 Cerebrospinal fluid: Chemistry and functions.
4.3 Mechanism of reflex action.
4.4 Physiology of environmental stress and strain- tolerance, avoidance, resistance and physiological adaptations.

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Semester-I

Paper-III, Cell Biology and Genetics

Unit-I

1.1 Membrane structure and function - structure of model membrane, lipid bilayer, membrane protein diffusion, osmosis, active transport, uniport, multiport, symport, antiport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

1.2 Structural organization and functions of cell organelles- nucleus, mitochondria, endoplasmic reticulum, Golgi complex, lysosomes and peroxisomes.

1.3 Structure and Functions of microfilaments, microtubules and their role.

1.4 Cell division and cell cycle - phases of cell cycle, checkpoints of cell cycle, regulation of cell cycle, mitosis, meiosis.

Unit-II

2.1 Cell signaling - hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, Receptor protein- tyrosin kinase and ion chanel receptors.

2.2 Signal transduction pathways, primary and secondary messenger systems, regulation of signaling pathways.

2.3 Cellular communication - general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix and integrins.

2.4 Cancer - genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis.

Unit-III

3.1 Mendelian, non-Mendelian inheritance - mono / dihybrid inheritance, types of dominance, multiple allelism, probability, exercises for solving genetics problems.

3.2 Extensions of Mendelian principles - codominance, incomplete dominance, gene interactions, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

3.3 Quantitative Genetics - polygenic traits and mode of inheritance, analysis of variation, genetic and environmental factors, heritability, inbreeding and consequences, coefficient of inbreeding and consanguinity.

3.4 Mutation - types, causes and detection, mutant types- lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants.

Unit-IV

4.1 Structural and numerical alterations of chromosomes - deletion, duplication, inversion, transversion, translocation, ploidy and their genetic implications.

4.2 Extra chromosomal inheritance - cytoplasmic inheritance, inheritance of mitochondrial genes, maternal inheritance.

4.3 Microbial genetics - recombination in bacteria and gene mapping, transformation, conjugation, transduction (generalized and specialized), fine structure mapping of genes.

4.4 Human genetics- pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

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Semester-I

Paper-IV, Advanced Reproductive Biology

Unit-I

1.1 Various methods of asexual and sexual reproduction in Protozoa.
1.2 Regeneration in *Hydra*, *Dugesia* and Annelid worms; Morphogenesis and hormonal control.
1.3 Metamorphosis in insects: Partial and complete metamorphosis, metamorphic forms nymph, larvae and pupae.
1.4 Mechanism of vitellogenesis in insects.

Unit-II

2.1 Spermatogenesis: Process, hormonal control and ultra-structure of spermatozoa of man.
2.2 Mechanism of oogenesis: Process, biochemical events, hormonal regulation.
2.3 Cytological and molecular events of fertilization.
2.4 Types of cleavage, blastulation, gastrulation and embryonic induction.

Unit-III

3.1 Male accessory sex glands in mammals: structure, secretion and functions.
3.2 Semen- biochemical composition and sperm abnormality.
3.3 Sperm capacitation and decapacitation- molecular mechanism and significance.
3.4 Pheromones and sexual behavior in mammals.

Unit-IV

4.1 Neuro-hormonal control of fish reproduction and mechanism of vitellogenesis.
4.2 Molecular induction (Morphogenetic gradients) and organizer concept.
4.3 Cryopreservation of gametes, embryo and test-tube baby.
4.4 In vitro fertilization (IVF) and its significance.

M.Sc. Semester I

Practical-I - Structure and Function of Invertebrates and General Physiology

Section-A

1. Study of museum specimens using already available specimens in the museum/ charts/ models/ photographs/ digital alternatives etc.

Classification upto order and comments on the specimens representing all phyla.

2 Anatomical Observations

Anatomical observations, demonstration and detailed explanation of

a) D**igestive system** of Earthworm, Leech, Cockroach, Silkworm and Honey bee

b) N**ervous system** of Prawn, Cockroach, Silkworm and Honey bee and

c) R**eproductive system** of Earthworm, Leech, Cockroach and Honey bee with the help of ICT tools/
Models/ Charts/ Photographs etc.

3 Mounting

Whole mount preparation of plankton and/or study of permanent preparation of the following with the help of already available permanent slides/ ICT tools/ charts/ photographs etc**.**

a. Earthworm – Nerve ring, ovary, spermatheca, nephridia.
b. Leech – jaws, ciliated organ.
c. Cockroach – Mouth parts, Salivary glands, trachea.
d. Prawn –Appendages, Statocyst.
e. Protozoans- rhizopods , flagellates , ciliates (fresh water forms).
f. Porifera – Spicules and gemmules of fresh water sponges.
g. Crustaceans and rotifers - Planktonic copepodes, cladoceran, ostracoderm and rotifers.
h. Larval forms of the free living invertebrates.
i. Larval forms of parasitic invertebrates.

4 Study of permanent Invertebrate slides

a. Porifera – T.S. and L.S. of *Sycon*, gemmules, spongian fibres, spiculesCo
b. elenterata – T.S. of *Hydra* , T.S. of Sea anaemon, Ephyra larva

c. Helminths – T.S. of *Planaria,* T.S. of *Taenia* , scolex W.M., Mature , gravid proglotids , T.S. of male and female *Ascaris*, W.M of *Ankylostoma* , *Enterbios*, *Dracunculus*, *Wuchereria*

d. Annelida -T.S. of *Nereis*, T.S. of Earthworm passing through various organs, T. S. of Leech.

e. Arthropod larvae – Nauplius, Zoea, Metazoea, Megalopa, Mysis.

f. Mollusca – T.S. of foot, Veliger and Glochidium larva.

g. Echinodermata- pedicellarae, T.S. of arm of star fish, Bipinnaria, Oricularia larva.

h. Hemichordata – T.S. through collar, proboscis, trunk and branchio-genital regions. Tornaria larva.

Section-B

Physiology experiments –

a. Total leucocyte count and differential leucocyte count.
b. Total R.B.C. count.
c. Demonstration of action of salivary amylase, trypsin, pepsin.
d. Demonstration of rate of O2 consumption in aquatic animals, under various environmental stresses.
e. Demonstration of haemoglobin concentration in normal and pathological condition.
f. Estimation of sodium, potassium and chloride in blood and excretory organs by Colorimeter or flame photometer (Source of blood: Local recognized pathology laboratory).
g. Estimation of glucose in blood by spectrophotometer or Colorimeter (Source of blood: Local recognized pathology laboratory).
h. Estimation of total blood proteins by spectrophotometer or Colorimeter (Source of blood: Local recognized pathology laboratory).
i. Estimation of cholesterol in blood by spectrophotometer or Calorimeter (Source of blood: Local recognized pathology laboratory).

Distribution of Marks: Marks

1. Anatomical observations	10
2. Stained permanent preparation:	10
3. Identification and comment on the spots (1-10)	30
4. Physiology experiment (Major)	15
5. Physiology experiment (Minor)	10
6. Submission of stained permanent slides	05
7. Class Record	10
8. Viva-voce	10

Total marks 100

M.Sc. Semester - I

Practical-II - Cell Biology, Genetics and Advanced Reproductive Biology

Section-A

1. Study of mitotic metaphasic chromosomes in plant material.
2. Preparation of human karyotypes by using photographs/pictures.
3. Demonstration of Barr body in human female leucocytes.
4. Demonstration of polytene chromosome in dipteran larvae with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
5. Problems on genetics based on monohybrid/dihybrid ratios, sex linked inheritance and blood groups.
6. Study of various human genetic traits.

Section-B

1 Study of meiotic chromosomes and spermatogenesis in grasshopper with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.
2 Demonstration of oogenesis in earthworm/ fish/ rat ovary with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
3 Semen analysis: physical viscosity, pH, liquefaction time, agglutination test, motility and sperm count (Source of semen: Government artificial insemination centre).
4 Sperm vitality study using suitable stains (Source of semen: Government artificial insemination centre).
5 Hypo-osmotic swelling (HOS) for the assessment of normal semen.
6 Study of vaginal smear in rat by temporary mounting (methylene blue) or by permanent stained (Haematoxylin-eosin) with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.
7 Histology of male and female reproductive organs and accessory reproductive glands with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

Distribution of Marks

1. Cytological preparation	20
2. Problems on genetics (any two)	20
3. Spermatogenesis/oogenesis/sperm vitality	15
4. Sperm count/vaginal smear/hypo-osmotic test for fertility	10
5. Identification and comment on spots (1-5)	15
6. Class record	10
7. Viva-voce	10

Total marks	100

List of Books for reference

M.Sc. Zoology Semester – I

Paper I :- Structure and function of Invertebrates

1. Hyman L.H. -The Invertebrate Vol. I, Protozoa through Ctenophora. McGraw-Hill Co., New York.
2. Barrington E.J.W.- Invertebrate structure and function. Thomas Nelson and sons Ltd., London.
3. Jagerstein G. -Evolution of Metazoan life cycle . Academic press, New York and London.
4. Hyman L.H. -The invertebrate McGraw-Hill Co., New York.
5. Barnes R.D. -Invertebrate Zoology W.B. Saunders and Co., Philadelphia
6. Hyman L.H. -The Invertebrates, smaller coelomate groups. Vol. 5 McGraw-Hill Co. New York.
7. Marshall A.J. and Williams W.D. -(1972) J. B. Zoology of Invertebrates , ElBs and McMillan,London.
8. Backlemiccher W.N. -Principles of comparative anatomy of Invertebrates Oliver and Boyed Edinberg.
9. Hadisi J. -The Evolution of Metazoa. Pergamon Press, Oxford.
10. Dales R.P.- Annelids, Hutchinson, London.
11. Green J. -Biology of Crustacea, Wither by, London.
12. Morton J. E. -Mollusca, Hutchinson, London.
13. Nichols D. -Echinodermata, Hutchincon, London.

Paper II : General Physiology

1. Bell, G.E. & Davidson, J.N. & Emslie D. Smith- Text Book of Physiology & Biochemistry.
2. Medical Physiology: A Wiley Medical Publication, John Wiley & Sons, New York.
3. Comar, C.L. & Felix Bronner (1961) - Mineral Metabolism, Acad Press, New York & London.
4. Dayson (1964)- A Text Book of General Physiology: Little Brown & Co. Boston.
5. R. Eckert & D. Randall (1983) - Animal Physiology: W.H. Rexeman & Co.

6. M.A. Edwards & K.A. Hassall (1980) - Biochemistry & Physiology of the Cell: (2nd Edn.), Mc. Graw Hill Co.
7. Cuthe F. (1968)- The Physiology of Cells: The Macmillan Co.
8. Guyton, A.G. (1968)- Textbook of Medical Physiology: 7th Edn. Saunders Pub.
9. C.L. Prosser - Comparative Animal Physiology ,W.B. Saunders & Company.
10. R. Eckert - Animal Physiology: Mechanism & Application, W.H. Freeman & Company.
11. W.S. Hoar- General & Comparative Animal Physiology.
12. W.F. Ganong (1981) -Medical Physiology 10th Edn. Lange Medical Publications.

Paper III : Cell Biology and Genetics

1. De Robertis- E. D. P., - Cell and Molecular Biology , I. S. E. publication.
2. Turner P. C. and Mc Lennan - Molecular Biology ; Viva Books Pvt. Ltd.
3. Benjamin Lewis - Gene VIII , Oxford press.
4. Watson J. D. - Molecular biology of Gene ., Benjamin publication.
5. Darnell J. - Molecular cell Biology ; Scientific American Books USA.
6. Alberts B., Bray D. Lewis J.- Molecular Biology of the Cell , garland publishing Inc.
7. Laodish H., Berk A., Zipursky S. L., Matsudaira P., Baltimore D. and Darnell J., - Molecular Cell
   Biology W. H. Freeman and Co.
8. Cooper G. M. - The Cell: Molecular Approch

Paper IV : Advanced reproductive Biology

1. S.F. Gilbert. 4th Edn. - Developmental Biology, Sinauer Associates Inc. Publishers.
2. Lewis Wolpert et al. 1998. - Principles of development: Oxford University Press.
3. Balinsky (1981) 5th Ed. - An Introduction to Embryology: (CBS College Publishing).
4. Austin and Short - Embryonic and foetal development. Cambridge University Press 1982, 1994
   2nd Ed.
5. Marshall's Physiology of Reproduction Longmont, Green and Co. London Vol. 1 & 2. Lamming
   1984, 2000.

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Semester-II

Core 5 - Paper- V - Structure and Function of Vertebrates

Unit-I

1.1 Origin and ancestry of Chordata.

1.2 General organization and affinities of Cephalochordata.

1.3 Structure, development and metamorphosis of Amoecoetus.

1.4 General characters and affinities of Dipnoi.

Unit-II

2.1 Organs and mechanism of respiration in Pisces and Amphibia.

2.2 Vertebrate integument and its derivatives.

2.3 Appendicular skeleton (Limbs and girdles) in Amphibia, Reptilia, Aves and Mammals.

2.4 General body organization and classification in Chelonia.

Unit-III

3.1 Evolution of urinogenital organs in vertebrates.

3.2 Origin of Birds.

3.3 Cetacia: general characters and adaptations.

3.4 Comparative anatomy of the brain in vertebrates (teleost, frog, lizard, fowl and rat).

Unit- IV

4.1 Autonomous nervous system in vertebrates: structure and functions.

4.2 Evolution of heart in vertebrates.

4.3 Sense organs in vertebrates.

4.4 Evolution of Man.

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Semester-II

Core 6 - Paper-VI - Comparative Endocrinology

Unit-I

1.1 Hormones and functions in Coelentereta and Helminths.

1.2 Neurosecretory system in Annelida: structure, hormones and functions.

1.3 Neuroendocrine system in Mollusca: structure, hormones and functions.

1.4 Hormones and functions in Echinodermata.

Unit-II

2.1 Neuroendocrine system in crustacean; structure and hormones.

2.2 Endocrine control of metamorphosis, reproduction and colour change mechanisms in crustacea.

2.3 Cephalic neuroendocrine system in insects: structure and hormones.

2.4 Endocrine control of metamorphosis and reproduction in insects.

Unit-III

3.1 Pineal organ: structure, hormones and functions.

3.2 Hypothalamo hypophysial system: structure, hypothalamic nuclei, hormones and function.

3.3 Pituitary: cell types, hormones and functions.

3.4 Thyroid: Structure, hormones and function.

Unit-IV

4.1 Parathyroid ultimobranchial glands: Structure, hormones and regulatory mechanisms.

4.2 Gastro-entero-pancreatic endocrine system: endocrine pancreas and gastro intestinal tract: endocrine cells, hormones and functions.

4.3 Adrenal gland: structure, hormones and functions in vertebrates.

4.4 Gonadal hormones in vertebrates and their hormonal actions, feedback mechanisms.

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Semester-II Core 7 - Paper-VII - Molecular Biology and Biotechnology

Unit-I

1.1 Cot ½ and Rot ½ values, organelle genome, DNA structure, forms of DNA.
1.2 DNA replication – molecular mechanisms of prokaryotic and eukaryotic DNA replication, regulation of replication.
1.3 DNA damage and repair – types of DNA damages, excision repair system.
1.4 Mismatch repair, recombination repair, double strand break repair, and transcription coupled repair.

Unit-II

2.1 Transcription- prokaryotic and eukaryotic transcription, RNA polymerases, transcriptional unit, initiation, elongation, termination, transcriptional factors.
2.2 Regulation of transcription – Operon, positive and negative control, attenuation phage strategies, anti-termination, response elements and inducible elements.
2.3 Translation - prokaryotic and eukaryotic translation, genetic code, altered code in elongation, termination factors, fidelity of translation, post translational modifications.
2.4 Mobile DNA elements – transposable elements, IS elements, P elements, retroviruses, retrotansposons.

Unit-III

3.1 Antisense and ribozyme technology – initiation of splicing, polyadenylation, molecular mechanisms of antisense molecules, miRNA, siRNA, gene silencing.
3.2 Isolation and sequencing of DNA, gene amplification, PCR, RAPD, RFLP, Maxam-Gilbert, Sanger's dideoxy methods.
3.3 Splicing and Cloning – Cloning vectors for recombinant DNA technology- plasmids, cosmids, phagemids, YACS, gene replacement, restriction enzymes.
3.4 Hybridization techniques – Southern- Northern hybridization, microarray.

Unit-IV

4.1 Medical biotechnology- Application of restriction fragment length polymorphism (RFLP) in forensic science, disease prognosis and genetic counseling.
4.2 Agricultural biotechnology- biofertilizers, bioinsecticides, biogas.
4.3 Immunobiotechnology-Hybridoma technology and monoclonal antibodies.
4.4 Industrial and Environmental biotechnology-microbial production of fermentation products, enzymes, antibiotics, single Cell proteins and biosensors.

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Semester-II

Core 8 - Paper-VIII - Advanced Developmental Biology

Unit-I

1.1 Implantation in Mammals.

1.2 Foetal membranes- types structure and functions.

1.3 Placenta-types, structure, functions. Hormones of placenta and their functions.

1.4 Metamorphosis in Amphibia: morphogenetic and biochemical mechanism, hormonal control.

Unit-II

2.1 Regeneration in vertebrates: tail, limb, lens and retina.

2.2 Apoptosis- mechanism and significance.

2.3 Ageing- mechanism, concepts and models.

2.4 Polymorphism (caste differentiation) in insect (Termites, Honey bees and Ants).

Unit-III

3.1 Multiple ovulation and embryo transfer technology (MOET).

3.2 Application of embryonic stem cells, clinical and economic significance.

3.3 Embryonic sexing, cloning, screening for genetic disorder diagnosis (ICSI, GIFT etc.)

3.4 Cloning of animals by nuclear transfer.

Unit-IV

4.1 Immunocontraception- fertilization, inhibition and pregnancy termination.

4.2 Classical contraceptive techniques: Physical, chemical, surgical and IUCD devices.

4.3 Anti-androgen and anti-spermiogenic compounds (LDH-CY and SP-10)

4.4 Role of mutants and transgenics in human welfare.

M.Sc. Semester-II

Practical-III - Structure and Function of Vertebrates and Comparative Endocrinology

Section-A

1. Study of museum specimens using already available specimens in the museum/ charts/ models/ photographs/ digital alternatives etc.

Classification of vertebrates up to order and comments on the specimens representing all phyla.

2. Anatomical Observations

Anatomical observations, demonstration and detailed explanation of the following with the help of ICT tools/ models/ charts/ photographs etc.

a) Brain and cranial nerves- Fish/ Rat.

b) Arterial and venous systems- Fish/Rat

c) Urinogenital system- Fish/Rat.

d) Reproductive systems- Fish/Rat.

e) Internal ear in fish, Weberian ossicles in fish, accessory respiratory organs in fish.

3. Mounting:

Study of Stained Permanent preparation of scales, ampullae of Lorenzini, otolith, striated muscles and cartilage of fish using animal wastes from local recognized fish markets or with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

4. Microtomy, Histology and Skeleton

a. Fixation, embedding, sectioning and staining of the internal organs of vertebrates (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)

b. Study of slides of internal organs of vertebrates with the help of already already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

c. Axial and appendicular skeleton of fowl and rabbit using already available skeleton/ ICT tools/ models/ charts/ photographs etc.

Section-B

1. **Microtomy** - Fixation, embedding, sectioning and staining of the endocrine gland (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry farms/ fish markets etc.)

2. **Histological study** – a) Histological slide of endocrine glands and gonadal endocrine components, EM structure of endocrine gland. b) Identification of pituitary cell type. c) Identification of α, β, γ, cells of Islets of Langerhans with the help of already available permanent slides/ ICT tools/ charts/ photographs etc.

3. **Anatomical Observations-** Anatomical observations, demonstration and detailed explanation of the endocrine glands in a) Cockroach and b) Endocrine glands- pituitary, thyroid parathyroid, adrenal in fish/rat with the help of ICT tools/ models/ charts/ photographs etc.

Distribution of Marks

1. Anatomical observations of fish/rat	15
2. Stained permanent preparation:	10

3. Identification and comment on the spots (1-10)	30
4. Submission of stained permanent slides	05
5. Anatomical observations of Endocrine glands	10
6. Histological staining of endocrine gland	10
7. Class Record	10
8. Viva-voce	10

Total marks 100

M.Sc. - Semester-II

Practical –IV - Molecular Biology, Biotechnology and Developmental Biology

Section-A

1. Demonstration of glycogen/ carbohydrate- PAS reaction (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
2. Demonstration of DNA: Feulgen's reaction (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
3. Demonstration of DNA: RNA: Methyl Green- Pyronin reaction (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
4. Demonstration of Lipid: Sudan Black B staining (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
5. Demonstration of Protein: HgBP staining (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
6. Histochemical analysis of alkaline phosphatase (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
7. Histochemical analysis of acid phosphatase (Source of tissue: Animal wastes from local recognized slaughter houses/ poultry forms/ fish markets etc.)
8. Biochemical estimation of sugar: O-toluidine method (Source of blood: Local recognized pathology laboratory)
9. Biochemical estimation of protein: Lowrey's method (Source of blood: Local recognized pathology laboratory)
10. Biochemical estimation of DNA: Diphenylamine method (Source of blood: Local recognized pathology laboratory)
11. Biochemical estimation of RNA: Orcinol method (Source of blood: Local recognized pathology laboratory)To perform tests for qualitative analysis of saliva
12. To perform tests for qualitative analysis of bile
13. Demonstration of separation of amino acids by paper chromatography and TLC

Section-B

1 Study of the reproductive system in mammals with the help of ICT tools/ models/ charts/ photographs etc.

2 Study of different types of eggs on the basis of their yolk content.

3 Study of developmental stages of live eggs of Lymnea or any gastropod with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

4 Study of developmental stages of insects/ fishes with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

5 Study of developmental stages of frog with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

6 Chick embryo mounting by window method.

7 Study of developmental stages of chick through slides and whole mounts.

8 Morphological study of different types of placenta with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

9 Histological study of placenta with the help of already available permanent slides/ ICT tools/ models/ charts/ photographs etc.

10 Sperm count from any domestic animal (Source of semen: Government artificial insemination centre).

M.Sc. - Semester-II

Practical –IV - Molecular Biology, Biotechnology and Developmental Biology

Distribution of Marks Marks

1. Histochemical demonstration of DNA/RNA protein / carbohydrate/lipids/enzymes	20
2. Estimation of sugar/protein/DNA/RNA/ qualitative analysis of saliva/bile	20
3. Whole mount preparation of chick embryo/sperm count.	15
4. Preparation of development stages of live eggs of Lymnea	10
5. Identification and comment on spots (1-5)	15
6. Class record	10
7. Viva voce	10
Total marks	100

List of Books for reference

M.Sc. - Semester-II

Structure and function of Vertebrates

1. Alexander R.N., The Chordata, Cambridge University Press London.
2. Barrington EJW, The Biology of Hemichordates and Protochordates, Oliver and Boid Edinberg.
3. Bourne G.H., The structure and function of nervous tissue Academic press New York.
4. Kingslay J.S, Outlines of Comparative anatomy of vertebrates, Central Book Depot, Allahabad.
5. Honyelli A.R. The Chordates Cambridge University Press, London
6. Smith H.S. Evolution of Chordate structure, Hold Rinehart and Wintoin Inc. New York
7. Walter H.A. and Sayles L.D. Biology of Vertebrates Macmillan and co. New York
8. Romer A.S. Vertebrate body W.P. Sanders co., Philadelphia.
9. Young J.Z. Life of Vertebrates Oxford University Press, London.
10. Young J.Z. Life of Mammals Oxford University Press, London.
11. Colbert E.H. Evolution of Vertebrates John Wiley and sons Inc. New York.
12. Kent C.J. Comparative anatomy of Vertebrates.
13. Waterman A.J. Chordate Structure and Functions Macmillan Co. New York.
14. Montagna W. Comparative anatomy clarenden press, Oxford
15. Weichert C.K. Preach W. Elements of Chordates anatomy McGraw-Hill book co., New York.
16. Lovetrup S. The phytogeny of Vertebrates John Wiley and sons Inc., London.
17. Joysey K.A. and Kemp T.S. Vertebrate Evolution Oliver and Boyd, Edinberg.
18. Romer A.S. Vertebrate Paleontology University of Chicago Press, Chicago.
19. Newman Phylum Chordata.
20. Goodrich E.S. Structure and development of vertebrates. Dover publications Inc., New York
21. Hard disty M.W. and Potter I.C. Biology of Lampreys Academic Press Newyork
22. T.B.of Zoology Parker and Haswell W.A. Mac millon co. Ltd. London
23. The Biology of Amphibia Noble G.K. Dover Publication Inc Newyork

Comparative Endocrinology

1. General & Comparative Endocrinology: E.J.W., Barrington, Oxford, Clarendon Press.
2. Text Book of Endocrinology: R.H. Williams, W.B. Saunders.
3. Endocrine Physiology: C.R. Martin, Oxford University Press.
4. Comparative Endocrinology: A Gorbman et al, John Wiley & Sons.
5. Medical Physiology: W.F. Ganong (1981): 10th Edn. Lange Medical Publications.
6. Principles of Anatomy and Physiology: Tortora Grabowski, 9th Edn., John Willey & Sons.
7. Reproductive Physiology of Vertebrates: Van Tienhoven, A. (1983): 2nd Edn. Cornell Univ. Press,
   New York.
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