

MAHARSHI DAYANAND SARASWATI UNIVERSITY,  
AJMER

पाठ्यक्रम

# SYLLABUS

SCHEME OF EXAMINATION AND  
COURSES OF STUDY

FACULTY OF SCIENCE

**B.Sc. BIOTECHNOLOGY**

B.Sc. Part-I Examination w.e.f. - 2010

B.Sc. Part-II Examination w.e.f. - 2011

B.Sc. Part-III Examination w.e.f. - 2012



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Purani Mandi, Ajmer

### NOTICE

1. Change in Statutes/Ordinances/Rules/Regulations/ Syllabus and Books may, from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any change that applies to years he has not completed at the time of change. **The decision taken by the Academic Council shall be final.**

### सूचना

1. समय-समय पर संशोधन या पुनः निर्माण कर परिनियमों /अध्यादेशों / नियमों / विनियमों / पाठ्यक्रमों व पुस्तकों में परिवर्तन किया जा सकता है, तथा किसी भी परिवर्तन को छात्र को मानना होगा बशर्ते कि विश्वविद्यालय ने अन्यथा प्रकार से उनको छूट न दी हो और छात्र ने उस परिवर्तन के पूर्व वर्ष पाठ्यक्रम को पूरा न किया हो। **विद्या परिषद द्वारा लिये गये निर्णय अन्तिम होंगे।**

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Published and Printed by ALKA PUBLICATIONS, AJMER

☎ 0145-2426301

for Maharshi Dayanand Saraswati University, Ajmer

### **B.Sc. Biotechnology 2009-10**

The course covers how life began on earth (Cosmogogenesis & Evolution), what are the molecules of Life (Biochemistry, Molecular Biology), what is the structure of life (Cytology & Developmental Biology), how life continues (Principles of Genetics, Molecular Biology) how is it maintained (Comparative physiology, Biophysics), how does it respond to the environment (Ecology & Environmental Biotechnology), how organisms interact with each other (the offense & defence), how mathematics helps biology (elementary mathematics & Biostatistics), what aids we need to study organisms (Biophysics, Biotechniques), how life may be manipulated (Genetic Engineering), what organisms offer us and how they might be turned into factories (Microbial, Plant, Animal resources & technology, Fermentation Technology).

#### **Scheme of Examination**

1. There are 6 theory papers per year dedicated to biotechnology and allied sciences each carrying maximum 50 marks in biotechnology. Each year there will be a combined practical examination of 150 marks for biotechnology. Along with these 6 papers every year, regular 3 papers of Chemistry being run in B.Sc. Botany, Zoology, Chemistry group shall be essential for all students opting for B.Sc. Biotechnology course.
2. Each theory paper is divided into three units. Question paper for each theory paper will have three sections: Part A, B and C.
3. Part A (Maximum 10 marks) will have 10 questions of 1 mark each, all of which must be attempted by the candidate. This question will have at least three questions set from each unit of the course contents of the paper. Word limit for the answers is 20 only.
4. Part B (Maximum 10 marks) of the question paper will have 5 compulsory questions. A minimum of 1 question will be asked from each unit of the course content of the paper. Each question will carry 2 marks. Word limit for the answer is 50 only.
5. Part C (Maximum 30 marks) will have total 3 questions, one from each unit of the course content of the paper. Each question will carry 10 marks and will have one choice from the same unit. Word limit for the answer to each question is 400 only.
6. A combined practical examination (Maximum 150 marks with break up as below) shall be conducted at the end of each year.

**a. Experimental work** (Max. marks 100, 10 hrs. duration, to be completed in two days) shall be performed by each candidate as per the question paper set on the basis of prescribed course of practical\* each year as mentioned in the syllabus (\*concerned department depending upon the facilities available with them can modify syllabus up to a maximum of 10%).

**b. Date wise, signed record** (maximum 30 marks) of the experiments conducted by each student throughout the academic session shall be placed by him/her before the examining panel on the day of practical examination.

#### **c. Viva voce 20 marks.**

The number of paper and the maximum marks for each paper together with the minimum marks required for a pass are shown against each subject below. It will be necessary for a candidate to pass in the theory as well as the practical part of subject/ paper separately. First division will be awarded at >60% marks and second division at >48% marks of the aggregate marks obtained in all the three parts of B.Sc. Biotechnology. All the rest shall be declared to have passed the examination, if they obtain minimum passing marks in each subject as mentioned. No division shall be awarded at Part I and Part II.

4 / M.D.S.U. Syllabus / B. Sc. Biotechnology

S. No	Subject of the paper	Number of paper	Max Marks	Min Pass Marks	Duration
<b>Compulsory papers</b>					
1	Samanya Hindi or General English or Elementary Hindi or History of Indian Civilization		100	36	3 hr
2	Elementary Computer Applications		100	36	3 hr
3	Environmental Studies		100	36	3 hr
<b>B.Sc. Part I</b>					
C1	Inorganic chemistry	Chem I	50	18	3 hr
C2	Organic chemistry	Chem II	50	18	3 hr
C3	Physical chemistry	Chem III	50	18	3 hr
C4	Practicals	Chem IV	75	27	5 hr
B1	Cosmogenesis and evolution	BBT I	50	18	3 hr
B2	Biochemistry	BBT II	50	18	3 hr
B3	Biophysics & Biotechniques I	BBT III	50	18	3 hr
B4	Cytology & Developmental Biology	BBT IV	50	18	3 hr
B5	Principles of Genetics	BBT V	50	18	3 hr
B6	Microbial resources & technology	BBT VI	50	18	3 hr
B7	Combined practical	BBT VII	150	54	10 hr
<b>B.Sc. Part II</b>					
C5	Inorganic chemistry	Chem V	50	18	3 hr
C6	Organic chemistry	Chem VI	50	18	3 hr
C7	Physical chemistry	Chem VII	50	18	3 hr
C8	Practicals	Chem VIII	75	27	5 hr
B8	Comparative physiology	BBT VIII	50	18	3 hr
B9	Molecular Biology	BBT IX	50	18	3 hr
B10	Plant resources & technology	BBT X	50	18	3 hr
B11	Biophysics & Biotechniques II	BBT XI	50	18	3 hr
B12	Ecology & Environmental Biotechnology	BBT XII	50	18	3 hr
B13	Cellular interactions	BBT XIII	50	18	3 hr
B14	Combined Practical	BBT XIV	150	54	10 hr

*M.D.S.U. Syllabus / B. Sc. Biotechnology / 5*

<b>B.Sc. Part III</b>					
C9	Inorganic chemistry	Chem IX	50	18	3 hr
C10	Organic chemistry	Chem X	50	18	3 hr
C11	Physical chemistry	Chem XI	50	18	3 hr
C12	Practicals	Chem XII	75	27	5 hr
B15	Animal resources & technology	BBT XV	50	18	3 hr
B16	Genetic Engineering	BBT XVI	50	18	3 hr
B17	Elementary mathematics & Biostatistics	BBT XVII	50	18	3 hr
B18	Fermentation technology	BBT VIII	50	18	3 hr
B19	Biotech enterprises and socioeconomic issues	BBT IX	50	18	3 hr
B20	Emerging technologies	BBT XX	50	18	3 hr
B21	Combined Practicals	BBT XXI	150	54	10 hr

## 1. सामान्य हिन्दी

समय 3 घंटे

उत्तीर्णांक : 36

पूर्णांक : 100

निर्देश: इस प्रश्न-पत्र के प्राप्तांक श्रेणी निर्धारण में सम्मिलित नहीं किये जायेंगे।

अंक योजना-

( अ भाग )

गद्य एवं पद्य संकलन की विविध विधाएँ क्रमशः (25 + 25 = 50 अंक)

1. एक प्रश्न व्याख्याओं से संबंधित क्रमशः (10 + 10 = 20 अंक)

2. दो परिचयात्मक प्रश्न पाठ्य पुस्तकों से (15 + 15 = 30 अंक)

( ब भाग )

1. शब्द शुद्धि -5 अंक
2. वाक्य शुद्धि -5 अंक
3. पारिभाषिक शब्दावली (अंग्रेजी शब्दों के हिन्दी समानार्थक शब्द) -5 अंक
4. संक्षेपण -5 अंक
5. पल्लवन -5 अंक
6. वाक्यांश के लिए सार्थक शब्द -5 अंक
7. प्रारूप -5 अंक
8. शब्द युग्म: अर्थ-भेद -5 अंक
9. निबन्ध -10 अंक

6 / M.D.S.U. Syllabus / B. Sc. Biotechnology

**गद्य-संकलन**

1. ग्रामोत्थान- नानाजी देशमुख, दीनदयाल शोध संस्थान चित्रकूट
2. पर्यावरण और सनातन दृष्टि छगन मेहता, संक्रान्ति और सनातनता, संकलन से वागदेवी प्रकाशन बीकानेर
3. ठिठुरता हुआ गणतंत्र (व्यंग्य)- हरिशंकर परसाई, तिरछी रेखाएँ, वाणी प्रकाशन दिल्ली
4. लछमा (रेखाचित्र) महादेवी वर्मा, अतीत के चल चित्र वाणी प्रकाशन, नई दिल्ली
5. अग्नि की उड़ान (परिच्छेद 16) ए.पी.जे.अब्दुल कलाम प्रभात प्रकाशन, नई दिल्ली
6. भेड़ाघाट: मार्बल रॉक्स और धुआँधार - अमृत लाल बेगड़ अमृतस्य नर्मदा ग्रंथ, मध्यप्रदेश अकादमी, भोपाल, मध्यप्रदेश
7. आवाज का नीलाम (एकांकी) धर्मवीर भारती गद्य-प्रभा-डॉ. नवल किशोर पंचशील प्रकाशन, जयपुर
8. सावचेती विजयदान देथा, आउटलुक पत्रिका 03.10.2005
9. हिन्दी भाषा और उसकी विरासत - डॉ. विद्यानिवास मिश्र, हिन्दी साहित्य का पुनरावलोकन विद्या निवास मिश्र, प्रभा प्रकाशन, दिल्ली
10. सुसंग-कुसंग-सीताराम महर्षि, कृष्ण कुटीर, रतनगढ़, चुरू (राज.)
11. ये हैं प्रोफेसर शशांक-डॉ. विष्णुकान्त शास्त्री - 'स्मरण को पाथेय बनने दो' संग्रह, लोक भारती, इलाहाबाद (उ. प्र.)
12. तुलसी के काव्य में 'कुराज' और 'सुराज'- प्रो. सूर्य प्रसाद दीक्षित साहित्यिक डी 54, निराला, नगर लखनऊ (उ. प्र.)

**पद्य - संकलन**

1. गंगावतरण, भारतेन्दु हरिश्चन्द्र 'भारतेन्दु समग्र' संपादक, हेमंत भार्मा हिन्दी प्रकाशन संस्थान, वाराणसी (उ. प्र.)
2. गोवर्धन धारण, हरिऔध 'प्रिय प्रवास' महाकाव्य हिन्दी साहित्य कुटीर, वाराणसी(उ. प्र.)
3. भारत वन्दना मैथिलीशरण गुप्त 'मंगल-घट' काव्य ग्रंथ साहित्य (नीलाम्बर परिधान)सदन चिरगाँव, झाँसी (उ. प्र.)
4. समर शेष है रामधारी सिंह दिनकर 'परशुराम की प्रतीक्षा' ग्रंथ से, राजपाल एण्ड संस, दिल्ली
5. वीरों का कैसा हो बसन्त, सुभद्रा कुमारी चौहान 'सुभद्रा कुमारी चौहान' सम्पादक: सुधा चौहान साहित्य अकादमी, नई दिल्ली
6. चल पड़े जिधर दो डग, सोहन लाल द्विवेदी 'राष्ट्रीय गीत संग्रह' साहित्य अकादमी, नई दिल्ली
7. श्रम दयाकृष्ण विजय 'श्रम-धरा' अर्चना प्रकाशन, अजमेर
8. भारती की साधना इन्दुशेखर तत्पुरुष 'हमारा दृष्टि कोण स्मारिका' 70/75 मानसरोवर जयपुर (राज.)



## 8 / M.D.S.U. Syllabus / B. Sc. Biotechnology

### Books recommended

1. A.J. Thomson and A.V. Martinet : A Practical English Grammar (Oxford Paper Back)
2. S.Pit Corder : Intermediate English Practice Book (Orient Longman)
3. Bhaskaran and Hordburgh : Strengthen Your English (OUP 1973)
4. T.I.h. Smith – Pearce : The English Errors Of Indian Students (OUP)
5. I.K. Sharma and V.D. Singh : A Practical Course of English ( Ramesh Book Depot, Jaipur)

## 1. प्रारम्भिक हिन्दी

### (ELEMENTARY HINDI)

(सामान्य हिन्दी के स्थान पर केवल अहिन्दी भाषी क्षेत्रों से आए हुए विद्यार्थियों के लिए)

उत्तीर्णांक: 36

अवधि 3 घण्टे

पूर्णांक : 100

#### अंकों का विभाजन-

1. पुस्तकों पर आधारित 50 अंक
2. व्याकरण से संबंधित 20 अंक
3. रचना से संबंधित  
क. लोकोक्तियाँ तथा मुहावरे आदि 10 अंक  
ख. पत्र लेखन अथवा निबंध 20 अंक

#### पाठ्यक्रम :

1. अध्ययनार्थ पाठ्य पुस्तकें : क. निबंध-संग्रह , ख. कहानी संग्रह
2. व्याकरण : शब्द विचार, वाक्य विन्यास, वाक्य खण्ड, पद-क्रम का ज्ञान तथा इसमें होने वाली सामान्य त्रुटियों का ज्ञान।
3. रचना :  
क. मुहावरों तथा लोकोक्तियों का प्रयोग, काव्य में समान दिखाने वाले शब्दों का अर्थ-भेद और उनका वाक्यों में प्रयोग  
ख. पत्र लेखन, अथवा सरल निबन्ध।

#### पाठ्य पुस्तकें :

##### क. निबन्ध संग्रह

सुगम हिन्दी गद्य (सम्पादक) सूरज भान, राजपाल एण्ड सन्स, दिल्ली

##### ख. गल्पदशिका 2, 7 एवं 8 पाठों को छोड़कर

सं. एम. एल. गर्ग एवं कमला भटनाकर, कालेज बुक डिपो, जयपुर

##### ग. व्याकरण एवं रचना-

सुबोध व्याकरण एवं रचना- सं. श्री व्यथित हृदय संशोधन कर्ता- डॉ. अम्बाप्रसाद सुमन, श्री राम मेहरा एण्ड कम्पनी, आगरा।



OR

## HISTORY OF INDIAN CIVILISATION

(in lieu of compulsory subject of General Hindi and Foreign Students)

### Scheme of Examination

Min. Pass Marks 36      Duration: 3 hrs      M.M. 100

There will be following three parts in the question paper of this subject.

#### **Part A**      **Marks – 20**

**Note :** Part A will contain 10 question in all. candidate are required to attempt all question in 20 words each. All questions carry equal marks.

#### **Part B**      **Marks – 20**

Part B will contain 05 question having one internal choice. Candidate are required to attempt five questions 50 words each. All questions carry equal marks.

#### **Part C**      **Marks – 60**

Part C will contain 05 questions in all. Candidate are required to attempt 03 questions in 400 words each. All questions carry equal marks.

## HISTORY OF INDIAN CIVILISATION

### **Part 'A'**

Outline of Historical Development : Indus Valley and the Aryans. Rise of Territorial States, Rise of Empires-Mauryas, Gupta, Kushan & Vardhana.

### **Part B'**

Emergence and Impact of Islam, the Rajput and Akbar. The British Impact. The National Movement Tilak, Gandhi and Nehru.

### **Part 'C'**

Social Life and Cultural Heritage : Family, Caste, Education, Buddhism and Jainism, Bhakti Movement, Literary and Art Heritage. Epics, Kalidas. Tulsidas, Tagore, Sanchi Ajanta Temple Architecture, Mughal Architecture Rajput and Mughal Painting.

## 2. ELEMENTARY COMPUTER APPLICATIONS

Paper	Exam Hours	Marks	
		Max	Min
Theory	3	100	36

Theory Examination paper will be as follows:

Duration 3 hours, maximum marks 100, consisting of 100 objective type questions of 1 marks each.

### Syllabus

1. Introduction to Information Technology, evolution and generation of computers, type of computers, micro, mini, mainframe and super computer. Architecture of a computer system: CPU, ALU, Memory (RAM, ROM

### **10 / M.D.S.U. Syllabus / B. Sc. Biotechnology**

- families) cache memory, input/output devices, pointing devices.
2. Number system (binary, octal, decimal and hexadecimal) and their inter-conversions, character codes (ASCII, EBCDIC and Unicode). Logic gates, Boolean Algebra, machine, assembly and high level language including 3GL and 4GL.
  3. Concept of Operating system, need and types of operating systems, batch, single user, multi-processing, distributed and time-shared operating systems. Process and memory management concepts. Introduction to Unix, Linux, Windows, Windows NT systems and their simple commands.
  4. Internet: Concepts, email services, world wide web, web browsers, search engines, simple programs in HTML, type of HTML documents, document structure element, type and character formation, tables, frames and forms.
  5. Word processing packages, standard features like tool bar, word wrap, text formatting, paragraph formatting, effect to text, mail-merge.
  6. Presentation Packages: Slide creation, slide shows, adding graphics, formatting, customizing and printing.
  7. Computer Networking: Type of networks, LAN, MAN and WAN concept of technology, bridges and routers, gateways and modems, ISDN and leased lines, teleconferencing and videoconferencing.
  8. Multimedia technology: Introduction, framework for multimedia devices, image compression standards, JPEG, MPEG and MIDI formats.
  9. Database Management Systems: Data, field and records, information database, creation of a database file, insertion, deletion and updating of records, modifying structure, editing and browsing of records, searching, sorting and indexing of records, retrieving of records and report generation. Data processing in government organizations.
  10. E-commerce: Concept of e-commerce, benefits and growth of e-commerce, security considerations and hazards of virus and other security risks, anti-virus software, electronic payment system.

#### **Laboratory:**

The laboratory exercises will be designed to help in the understanding of concepts of computer and the utilization in the areas outlined in the theory syllabus. The emphasis should be on practical usage rather than on theoretical concepts only. In addition, MS-Office package is to be practiced in the lab.

### **3. COMPULSORY PAPER OF ENVIRONMENTAL STUDIES**

Compulsory in I year for all streams at undergraduate level

Scheme of examination

Time 3 hrs

Pass Marks 36

Max. Marks 100

Theory

Theory paper will contain nine questions. The students are required to attempt

*M.D.S.U. Syllabus / B. Sc. Biotechnology / 11*

five question in all including question no.1 which will be compulsory.

Q1 short answer type. Ten question of two marks each (compulsory)

10×2 = 20 marks

Q2 to Q9 essay type question of 20 marks each (attempt any four)

The students are required to visit some field or sites mentioned in the syllabus under the guidance of a teacher. The teacher shall certify that the student have visited the site and should further inform their respective principal in writing regarding the same.

**Note:**

1. The marks secured in this paper shall not be counted in awarding the division to a candidate.
2. The candidate have to clear compulsory paper in three chances
3. Non appearing or absent in the examination of compulsory paper will be counted a chance.

**CORE MODULE SYLLABUS FOR ENVIRONMENTAL STUDIES FOR UNDERGRADUATE COURSES OF ALL BRANCHES OF HIGHER EDUCATION**

**Unit 1: The Multidisciplinary nature of environmental studies**

Definition , scope and importance

Need for public awareness.

**Unit 2: Natural Resources:**

Renewable and non-renewable resources:

- Natural resources and associated problems.
- a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) Water resources: Use and over-utilization of surface and groundwater, floods, drought, conflicts over water, dams-benefits and problems.
- c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Case studies.
- f) Land resources: Land as a resource, Land degradation, man induced Landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

## 12 / M.D.S.U. Syllabus / B. Sc. Biotechnology

### Unit 3: Ecosystems

- Concept of an ecosystem.
- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystem:
  - a. Forest ecosystem
  - b. Grassland ecosystem
  - c. Desert ecosystem
  - d. Aquatic ecosystems ( ponds, streams, lakes, rivers, oceans, estuaries)

### Unit 4: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### Unit 5: Environmental Pollution

#### Definition

- Causes, effects and control measures of:-
  - a. Air pollution
  - b. Water pollution
  - c. Soil pollution
  - d. Marine pollution
  - e. Noise pollution
  - f. Thermal pollution
  - g. Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

**Unit 6: Social Issues and the Environment**

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case Studies.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environmental Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and Control of Pollution) Act.
- Wildlife Protection Act.
- Forest Conservation Act.
- Issues involved in enforcement of environmental legislation.
- Public Awareness.

**Unit 7: Human Population and the Environment**

- Population growth, variation among nations.
- Population explosion- Family Welfare Programme.
- Environment and Human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

**Unit 8: Field Work**

- Visit to a local area to document environmental assets- river / forest / grasslands / hill/ mountain.
- Visit to local polluted site- Urban /Rural / Industrial /Agricultural.
- Study of common plants, insects, birds.
- Study of simple ecosystems- pond, river, hill slope, etc.

**स्नातक अनिवार्य विषय : पर्यावरण विज्ञान**

**इकाई प्रथम**

पर्यावरण अध्ययन की बहुआयामी प्रकृति, परिभाषा एवं महत्व जन जागृति की आवश्यकता

**इकाई द्वितीय : प्राकृतिक संसाधन**

**नवीनीकरण एवं अनवीनीकरण संसाधन : प्राकृतिक संसाधन एवं उससे संबंधित समस्याएं**

#### 14 / M.D.S.U. Syllabus / B. Sc. Biotechnology

1. **वन संसाधन** : उपयोग एवं अतिशोषण, वनोन्मूलन केस अध्ययन, टिम्बर निष्कर्षण, खनन एवं उनके वनों एवं जनजातियों पर प्रभाव
2. **जलसंसाधन** : सतही एवं भूजल का उपयोग एवं अतिउपभोग, बाढ़, सूखा, जल विवाद, बांधों की समस्याएं एवं लाभ
3. **खनिज संसाधन** : उपयोग एवं अतिशोषण, खनिज संसाधन के उपयोग एवं निष्कर्ष के पर्यावरणीय प्रभाव, केस अध्ययन
4. **खाद्य संसाधन** : विश्व खाद्य समस्याएं कृषि एवं अतिचारण के कारण होने वाले परिवर्तन, आधुनिक कृषि के प्रभाव, उर्वरक एवं पीड़कनाशक जनित समस्याएं, जलाक्रान्ति, लवणीयता, केस अध्ययन।
5. **ऊर्जा संसाधन** : बढ़ती हुई ऊर्जा आवश्यकताएं, नवीनीकरण एवं अवनीनीकरण ऊर्जा संसाधन, ऊर्जा संसाधनों का वैकल्पिक उपयोग केस अध्ययन।
6. **भूसंसाधन** : भूमि एक संसाधन, भूअपघटन, मानवजनित भूस्खलन मृदा अपरदन एवं मरुस्थलीकरण, प्रकृतिक संसाधनों के संरक्षण में व्यक्तिक भूमिका सतत् जीवनचर्या के लिए संसाधनों का उपयुक्त उपयोग।

#### इकाई तृतीय : पारिस्थितिकी तंत्र

- पारिस्थितिकी तंत्र की अवधारणा
- पारिस्थितिकी तंत्र की संरचना एवं कार्यप्रणाली
- उत्पादक, उपभोक्ता, अपघटक
- पारिस्थितिकी तंत्र में ऊर्जा प्रवाह
- पारिस्थितिकी अनुक्रमण
- खाद्य श्रृंखला, खाद्यजाल एवं पारिस्थितिकी स्तूप
- परिचय, प्रकार, विशेषताएं, गुण, संरचना एवं कार्यप्रणाली
- अ) वन पारिस्थितिकी तंत्र
- ब) घास के मैदान पारिस्थितिकी तंत्र
- स. मरुस्थल पारिस्थितिकी तंत्र
- द. जलीय पारिस्थितिकी तंत्र (तालाब, धारा, झील, नदियां, समुद्र)

#### इकाई चतुर्थ : जैव विविधता एवं संरक्षण

- परिचय – परिभाषा : जीनीय, प्रजातीय एवं पारिस्थितिकी विविधता
- भारत का जैवभौगोलिक वर्गीकरण
- जैवविविधता का महत्व, उपभोगीय उपयोगिता, उत्पादकीय उपयोगिता, सामाजिक, नैतिक सौन्दर्य बोध एवं वैकल्पिक मूल्य
- वैश्विक, राष्ट्रीय एवं स्थानिक स्तर पर जैव विविधता
- भारत : एक मैगाविविधता राष्ट्र
- जैवविविधता के तप्तस्थल

**M.D.S.U. Syllabus / B. Sc. Biotechnology / 15**

- जैवविविधता के खतरे : आवासक्षय, वन्यप्राणियों का शिकार, मानव-वन्यप्राणियों के बीच विरोधाभास
- भारत की विलुप्तप्राय एवं स्थानिक प्रजातियां
- जैव विविधता का संरक्षण : स्व स्थानीय एवं पूर्व स्थानी संरक्षण

**इकाई पंचम : पर्यावरणीय प्रदूषण**

- परिभाषा, कारण, प्रभाव एवं नियंत्रण उपाय
  - a) वायु प्रदूषण                      b) जल प्रदूषण                      c) मृदा प्रदूषण
  - d) समुद्री प्रदूषण                      e) ध्वनि प्रदूषण                      f) तापीय प्रदूषण
  - g) नाभीकीय खतरे
- टोस अपशिष्ट प्रबंधन : शहरी एवं औद्योगिक अपशिष्ट के कारण प्रभाव एवं नियंत्रण उपाय
- प्रदूषण निवारण में व्यक्तिगत भूमिका
- प्रदूषण केस अध्ययन
- आपदा प्रबंधन : बाढ़, भूकम्प, चक्रवात एवं भूस्खलन

**इकाई षष्ठम : सामाजिक मुद्दे एवं पर्यावरण**

- असतत् से सतत् विकास
- उर्जा से संबंधित शहरी समस्याएं
- जल संरक्षण, वर्ष जल संचयन, जल प्रवाह प्रबंधन
- लोगों का पुर्नवास एवं पुनः नियोजन
- समस्याएं एवं चिन्ताएं केस अध्ययन
- पर्यावरण नीति, मुद्दे एवं संभव समाधान
- जलवायु परिवर्तन, वैश्विक तापवृद्धि, अम्लवर्षा, ओजोनपरत क्षरण
- परमाणु दुर्घटनाएं एवं पूर्णाहुति, केस अध्ययन
- बंजर भूमि उद्धार
- उपभोक्तावाद एवं अपशिष्ट उत्पाद
- पर्यावरण निवारण नियम
- वायु निवारण (निवारण एवं नियंत्रण) प्रदूषण नियम
- जल (निवारण एवं नियंत्रण) प्रदूषण नियम
- वन्य जीव संरक्षण नियम
- वन संरक्षण नियम
- पर्यावरण कानूनों के प्रवर्तन में शामिल मृद्दे
- जन जागरूकता

**इकाई सप्तम : मानव जनसंख्या एवं पर्यावरण**

- जनसंख्या वृद्धि, राष्ट्रों के बीच भिन्नता
- जनसंख्या विस्फोट, परिवार कल्याण योजना

**16 / M.D.S.U. Syllabus / B. Sc. Biotechnology**

- पर्यावरण एवं मानव स्वास्थ्य
- मानव अधिकार
- मौलिक शिक्षा
- एच.आई.वी./एड्स
- महिला एवं शिशु कल्याण
- पर्यावरण एवं मानव स्वास्थ्य में सूचना एवं प्रौद्योगिकी की भूमिका
- केस अध्ययन (घटनात्मक/उदाहरणात्मक अध्ययन)

**इकाई अष्टम् : स्थानीय क्षेत्रों की यात्रा**

- पर्यावरण दस्तावेजों के लिये नदी/वन/घास के मैदान, पहाड़ी, पहाड़
- स्थानीय दूषित क्षेत्रों की यात्रा – शहरी/ग्रामीण/औद्योगिक/कृषि
- स्थानीय पेड़ों, कीड़ों एवं पक्षियों का अध्ययन
- सरल पारिस्थितिकी तंत्र का अध्ययन – तालाब, नदी, पहाड़ी तलहटी

**Syllabus for all essential papers and papers for chemistry shall be as prescribed for B.Sc. (Biology) course of the MDS University, Ajmer.**

**B.Sc. Part I**

- B1. Cosmogogenesis and evolution
- B2. Biochemistry
- B3. Biophysics & Biotechniques I
- B4. Cytology & Developmental Biology
- B5. Principles of Genetics
- B6. Microbial resources & technology
- B7. Combined practical

**B.Sc. Part II**

- B8. Comparative physiology
- B9. Molecular Biology
- B10. Plant resources & technology
- B11. Biophysics & Biotechniques II
- B12. Ecology & Environmental Biotechnology
- B13. Cellular interactions
- B14. Combined practical

**B.Sc. Part III**

- B15. Animal resources & technology
- B16. Genetic Engineering
- B17. Elementary mathematics & Biostatistics
- B18. Fermentation technology
- B19. Biotech enterprises and socioeconomic issues
- B20. Emerging technologies
- B21. Combined Practical



**B.Sc. Part I examination w.e.f - 2010**

**B1. Cosmogenesis and evolution**

**Section A**

Current perspectives of cosmogenesis. Wave particle dualism and particle physics revolution. Determinism and uncertainty principle. The concept of gravity, space and time.

The Big Bang. Condensation of primordial soup, Matter and anti matter, Grand Unification Theory, Fundamental particles, Quarks, Plasma, Theory of strings and Superstrings, Vibrating universe, Theory of inflation.

**Section B**

Models of self organization, Pattern and network, dissipative structures, Eigen's hypercycles, Autopoiesis. Requirements of life and living structures. Living beings as dissipative structures and nonequilibrium thermodynamics. Simplest possible mechanisms to yield energy, replicate information and contain the constituents.

Selection and Genetic drift. Molecular chronometers. Molecular methods to study evolution. Strategies of life: Variation and its mechanisms, redundancy,

**Section C**

Theory of endosymbiogenesis, sexual selection, mate selection, kin selection. Coevolution. Concept of niche and evolution of biodiversity, r- and K- selection theory, Fisher's theory of the evolution of mimicry, Theory of balanced polymorphism, Theory of allopatric speciation, Theory of phyletic gradualism, Theory of speciation in diploid species.

**Books:**

Fritzo Capra. 1996. Web of Life. Harper Collins Pub., London.

Lewis, Ralph W. 1980. Evolution: A system of theories. Perspectives in Biology & Medicine. (Summer) 551-572.

Guth, Alan H. 1997 : The Inflationary Universe. The quest for a new theory of cosmic origins. Helix Books, Perseus Books, Massachusetts.

Eigen Manfred. 1971. Molecular self organization and the early stages of evolution. Quarterly Rev. Biophysics. 4.149.

Margullis Linn & Dorian Sagan. 1995. What is life? Simon & Schuster, New York.

**B2. Biochemistry**

**Section A**

Composition of living matter: Water and its properties. Buffers, Solutions, Ionic equilibrium, pH, pK values. Handersen-Hasselbatch equation. Cell chemistry, constituents and their functions.

Amino acids: Structure and properties. Proteins their types with examples. Enzymes, mechanism of action, classification, Michaelis Menten equation. Regulation of enzymes: Allosteric, uncompetitive, Competitive, Non competitive.

## **18 / M.D.S.U. Syllabus / B. Sc. Biotechnology**

### **Section B**

Carbohydrates: Structure, function, classification of different types of carbohydrates with examples. Aldoses and ketoses. Haworth projection. Epimers, Isomers and Mucopolysaccharides.

Lipids: Structure function and classification. Triglycerides, waxes, phospholipids, polar and non polar lipids. Cholesterol, Sphingolipids, Cerebrolipids. Comparative account of types of lipids characteristic to plants, animals and microbial systems. Structure of cell membranes.

### **Section C**

Nucleic acids: Structure of nucleotides, nucleosides. Types of Nucleic acids, their functions, structure in prokaryotes and eukaryotes. Structure of DNA. Types of DNA conformations. Packaging of DNA into nucleosomes. Heterochromatin, euchromatin, Repetitive DNA, palindromes, concept of the gene. Introns and exons.

Vitamins and hormones, their types and functions.

## **B3. Biophysics & Biotechniques I**

### **Section A**

Thermodynamics: Warming, Cooling, Conduction, Heat capacity and specific heat, Latent heat, First law of thermodynamics. Temperature scales. Coefficient of thermal expansion. Perspiration, heat regulation in warm and cold blooded animals. Pressure Cooker. Metabolic rate and body size. Goose pimples. Bergamann's law. Second and third law of thermodynamics. Information: definition, unit, DNA as information molecule. Flow of energy through biosphere. Entropy, Enthalpy and bonding energy, phosphorylation. Does life violate the second law? Entropy and Probability, Nonequilibrium thermodynamics. Isolated Systems, Closed Systems near Equilibrium, Closed Systems Far from Equilibrium, Stochastic Processes, Markovian and Gaussian Processes, Brownian Motion, Random walk.

### **Section B**

Strategies of energy production in the cell, Redox reactions, coupled reactions and group transfer. ATP production. Transport, Free energy and spontaneity of reaction.  $G$ ,  $G^0$ ,  $G'$  and equilibrium. Mass and energy balance in metabolism. Metabolic heat generation. Fourier's law of heat conduction and analogy with momentum transfer. Convection and concept of heat transfer coefficient.

Asepsis and observation techniques: Principles of asepsis. Principles and techniques of sterilization, disinfection and antisepsis.

### **Section C**

Cultivation of microorganisms. Constructing nutrient media (Ingredients, Types). Environmental factors affecting growth of microorganisms. Isolation (Enrichment, selection, bait technique, isolating single spores), purification

techniques, maintenance and preservation of cells. Methods of cell disruption. Physical and chemical methods.

Methods of separation. Filtration techniques. Angular momentum, moment of inertia. Centrifugal and centripetal forces. Why one feels dizzy on a Merry-Go-Round. Centrifugation. Principles, types and applications. Chromatography and Electrophoresis: Principles types and applications.

**Books:**

Physics (1988), Machlup, Wiley International Edition, John Wiley and Sons, New York

## **B4. Cytology and developmental biology**

### **Section A**

Discovery of the cell. Cell Theory. Cell composition. Cell constituents. Biogenic elements. Periodic table and biogenic elements. Properties of water and carbon that help sustenance of life. Eukaryotic and prokaryotic cells. Plant and animal cells. Cell inclusions. Advantages of compartmentalization. Membrane systems not bound by unit membrane (Mesosomes, Thylakoids, Chlorosomes, Magnetosomes, Carboxysomes). Cytoskeletal structures (Microvilli, microtubules) and cell inclusions (storage bodies, pyrenoids, oil droplets, sulfur particles, volution granules).

### **Section B**

Diversity of cell types and their differences. Archaeobacterial cells, Eubacterial cells, Cell envelopes. Their types and distribution. Cell walls: structure and function. Cell membranes. Structure, function and models. Protein mosaic and lipid raft model. Translocation through membranes. Gates and thoroughfares. Excretion and uptake. Membranes as sites for energy generation and photo entrapment systems.

Cell appendages and surface architecture (Flagella, cilia, pili, capsule, sheath). Cell organelles, their structure and function: Endoplasmic reticulum, Golgi bodies, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus, Vacuoles. Cell cycle. Cell differentiation in prokaryotes (endospores, exospores, cysts, akinetes, heterocysts, asexual spores) and its need. Vegetative propagation. Somatic division. Asexual reproduction. Diversity of spores in algae, fungi, protozoa) and comparison of their structure and genesis. Reproductive division. Sexual reproduction. Spores (in algae, fungi, protozoa), their structure and genesis. Cell senescence and apoptosis.

### **Section C**

Tissues, their types, structure and function. Comparative histology of plants and animals. Growth and differentiation. Organs and organ systems. Vascular system in plants. Common features of Digestive, Excretory, Circulatory, Respiratory, Muscular, Skeletal, Nervous and sensory system in animals and evolution of complexity.

## 20 / M.D.S.U. Syllabus / B. Sc. Biotechnology

Embryology of plants and animals. Placentation in mammals, Embryonic stem cells, Biology of aging. Developmental biology morphogenesis, organogenesis. Developmental biology: neuroendocrine regulations, reproductive system, estrous and menstrual cycle. Gametogenesis, cleavage, differentiation, organogenesis.

### **B5. Principles of Genetics**

#### **Section A**

Mendelian principles: Principle of segregation, monoclinal crosses, dominance, codominance, semidominance, lethal genes. Principle of independent assortment: dihybrid ratios, trihybrid ratios, gene interactions, epistasis, multiple alleles. Meiosis and Mendel's principles.

Sex determination and linkage: Mechanisms of sex determination: Simple mechanisms, One or a few genes, identification of sex chromosomes, XX-XY mechanism, Y chromosome and sex determination in mammals

#### **Section B**

Balanced concept of sex determination in *Drosophila*, haploidy and sex determination in hymenoptera, Mosaics and gynandromorphs, environmental factors in sex determination, sex differentiation, sex influenced dominance, sex limited gene expression, sex linked inheritance.

Principles of linkage: Crossing over, cytological basis of crossing over, chromosome mapping by two factor crosses, interference, ordered tetrad data, somatic cell hybridization. Molecular mechanism of crossing over, gene conversion.

#### **Section C**

Classical versus molecular concept of the gene. Cis-trans complementation, deletion mapping, one gene-one band in *Drosophila* salivary gland chromosomes. Genes within genes.

Population Genetics: Behavioral genetics, Hardy-Weinberg frequencies, inbreeding, calculating F from pedigrees, outbreeding and assorted mating, genetic equilibrium, chemotaxis, inheritance and learning in bees, *Drosophila*: behavioural genetics, genetic and environmental interactions in dogs.

### **B6. Microbial resources & technology**

#### **Section A**

Classification of microorganisms. Haeckel's three kingdom and Whittaker's five kingdom concepts. Three domain concept of Carl Woese. Archaeobacteria and eubacteria. Classification and economic importance of algae, fungi, lichen and protozoa up to class level. Thallus organization and importance. Gram positive and Gram negative bacteria. Biology and importance of methanogens, actinomycetes, fermentative bacteria, rhizobiaceae, cyanobacteria and yeasts.

### **Section B**

Nutritional classification of bacteria. Functional diversity of bacteria (oxygenic and anoxygenic photosynthesis, fermentations, anaerobic respiration, diazotrophy, nitrification, denitrification, methylotrophy, methanogenesis, hydrogen production and uptake, sulfur oxidation and reduction). Economic importance of bacteria.

### **Section C**

Economic importance of protozoa and algae. Features and life history of *Amoeba*, *Paramecium*, *Euglena*, *Volvox*, *Oedogonium*, *Coleochaete*, *Vaucheria*, *Ectocarpus*, *Sargassum*, *Polysiphonia*.

Features and life history of *Pythium*, *Phytophthora*, *Mucor*, *Saccharomyces*, *Eurotium*, *Chaetomium*, *Peziza*, *Puccinia*, *Agaricus*, *Phomes*, *Cercospora*, *Colletotrichum*.

Acellular living entities (Viruses, virusoids, viroids, prions). Structure, multiplication and important diseases caused by them in man, plants, cattle, hogs, poult, fishes.

## **B7. Combined Practical**

### **Biochemistry**

1. Numerical exercises on normality, molarity, molality, percent solution, ppm, ppb solutions.
2. Measurement of pH.
3. Preparing buffer. Preparation of phosphate buffer and calculation of pH using Handerson Hasselbach equation
4. Estimation of intra and extracellular protein by Lowry's method.
5. Estimation of total carbohydrates by anthrone method
6. Phytochemical tests of the following: Glucose, starch, proteins, fats, tannins, ascorbic acid and anthocyanin.
7. Soxhlet separation of oils from seeds and its gravimetric estimation
8. Estimation of DNA content
9. Estimation of RNA content
10. Using a centrifuge, determine minimum time that will be required to settle algal/blood cells.

### **Microbiology**

1. Parts of a microscope. Handling. Precautions.
2. Obtaining Koehler illumination.
3. Types and use of different bright field microscopes. 1. Dissection microscope, 2. Stereo microscope and 3. Inverted microscope.
4. Calibration of a micrometer and micrometry of cells.
5. Microscopic enumeration of cells using
  - a. Drop method and
  - b. Cell Counters (Neubauer chamber/Hemocytometer/ Sedgwick Rafter cells)

## 22 / M.D.S.U. Syllabus / B. Sc. Biotechnology

6. Numerical exercises on determination of volume of a cell counter.
7. Simple staining of yeast/ molds
8. Identifying different types of spores of fungi- conidiospores, ascospores, basidiospores, uredospores, teleutospores, pycnidiospores)
9. Differentiating akinetes, heterocysts and vegetative cells in cyanobacteria
10. Microscopic identification of 5 representatives showing various thallus organizations, each of algae, fungi and cyanobacteria
11. Microscopic identification of 5 types of protozoans.
12. Differential staining: Gram staining bacteria
13. Ubiquity of microorganisms

### Cell biology & developmental biology

1. Endospore staining in bacteria
2. Sectioning, staining and observation of leaf, stem and root of monocot and dicot plants.
3. Histological slides of cleavage, blastula, gastrula, nerula and tail bud stages.
4. Study sex combs and giant chromosomes of salivary glands of *Chironomous* or *Drosophila*
5. Mitotic and meiotic studies in yeast/ onion root tips/ flower buds/ grasshopper testes/salivary glands of *Drosophila*
6. Demonstration of sexual reproduction in algae and protozoa by permanent slides.
7. Differentiating viable and nonviable cells by fluorescence microscopy

### In vitro Culture

1. Methods of sterilization: Wet heat, dry heat and filter sterilization. Sterilizing glassware.
2. Determining efficacy of aseptic techniques
3. Methods of disinfection: Physical and chemical, and their efficacy
4. Need, use and cleaning of laminar flow.
5. Preparation of stocks of inorganic compounds for culture media.
6. Preparing culture medium, its sterilization and pouring the plates, preparing tubes (Liquid, slants, stabs).
7. Selective cultivation of fungi, actinomycetes, bacteria and studies on their micro and macromorphological features.
8. Dual culture method for Protozoa. Cultivating Paramecium.
9. Cultivation of virus in chick embryo.

## B.Sc. Part II examination w.e.f - 2011

### B8. Comparative physiology

#### Section A

Comparative account of the mechanisms of food uptake in animals. Digestion of food. Uptake of the nutrients by plant, animals and microorganisms. Transport of nutrients across the cell membrane for energy, structure and

storage. Concept of exoenzymes and endo enzymes, bound and soluble enzymes.

#### **Section B**

Metabolism: Integration of catabolism and anabolism. Secondary metabolism, regulation of metabolic pathways, compartmentalization of metabolic pathways in microorganisms and higher organisms.

Photosynthesis. Diversity of Phototrophs. Chloroplast structure. Pigments involved in photosynthesis chlorophylls, carotenoids, xanthophylls, phycobillins. Light and dark reaction. C3 and C4 pathways. Comparison of photosynthetic systems of plants and bacteria, Photorespiration.

#### **Section C**

Respiration: Glycolytic pathway. Citric acid cycle, glyoxylate cycle. Pentose phosphate pathway, their significance, energetics and enzymology.

Electron transport chain, phosphorylation and ATP production. Anaerobic respiration, Fermentation. A comparative account of respiratory processes of microorganisms, plants and animals.

### **B9. Molecular Biology**

#### **Section A**

DNA as the genetic material. Hershey & Chase experiment. Conrat and Senger's experiment. Structure of DNA, Watson & Crick's Model, Types of DNA, Meselsen & Stahl's experiment, DNA replication, genome complexity, packaging of DNA into chromosomes. Euchromatin, heterochromatin, repetitive DNA, DNA denaturation and renaturation. Genetic information content- C-value paradox and reassociation kinetics. Genetic code, Steps of protein synthesis and their details. Structure and types of RNA and their functions

#### **Section B**

Transcription of RNA in prokaryotes and eukaryotes. Steps in transcription. Maturation and processing of RNA.

Translation: Comparison between prokaryotic and eukaryotic translation. Post translational processing of proteins.

Genetic recombination. Molecular aspects of recombination. Homologous and heterologous recombination. Holliday Model. Gene expression and organization in mitochondrion and chloroplast.

#### **Section C**

Regulation of expression in prokaryotes and eukaryotes. Operon concept. Inducible and repressible operons. Negative and positive regulation. Details of lac and tryp operon.

Gene control of development in *Drosophila*, hormonal control of gene expression, regulation of alternate pathways of transcript splicing, regulation of complex circuits of gene expression in eukaryotes.

## **B10. Plant resources & Technology**

### **Section A**

Basic features of anatomy of cryptogams and phanerogams. Diversity of forms of seeds, fruits, flowers, leaves, stems and roots.

Classification of plants upto family level. Vegetative and floral characteristics and economic importance of cucurbitaceae, Fabaceae, Cruciferae and Poaceae (Graminae). Pteridophytes with specific reference to *Azolla*.

### **Section B**

Forest products: *Tectona*, *Delbergia*, *Tecomella*. Medicinal plants: *Cinchona*, *Withania*. Pharmacological and ethnobotanical traditional medicines. Characterization and formulation of crude drugs in Ayurvedic system. Plant sources of homeopathic medicines. Fuel crops: Jojoba, *Euphorbia antisiphilitica*, *Calotropis procera* Characteristics, cultivation and extraction of oil. Edible and poisonous fungi. Cultivation of different types of mushrooms

### **Section C**

*In situ* and *ex situ* methods of conservation of phytodiversity. *In vitro* methods in plant tissue culture. Nutrient media. Use of growth regulators. *In Vitro* fertilization. Ovary and ovule culture. Micropropagation (clonal propagation), organ culture- anther, embryo, endosperm culture and their applications. Organogenesis and somatic embryogenesis-techniques and applications.

Protoplast culture- Isolation, regeneration, viability test, somatic hybridization, methods of protoplast fusion. Practical application of somatic hybridization and cybridisation. Somaclonal variations and their significance. *In vitro* production of secondary metabolites- techniques and significance. Plant cell suspension culture to produce saffron and capsaicin.

## **B11. Biophysics & Biotechniques II**

### **Section A**

Electromagnetic radiations: Light rays, refraction, Snell's law, Image by spherical surface, Diffraction, Interference, Single slit, many slit and 2-D gratings, resolving power of a grating, dispersion of a grating, Polarization, Frequency and wavelength, colour, spectrum.

Observing cells and microorganisms: Principles of microscopy. Electromagnetic radiations, magnification, numerical aperture, resolving power, chromatic aberrations. Development of microscopes from simple bright field to electron microscopes. Types of microscopy, principles and uses: Visible light (Dark and bright field), Fluorescence microscopy. UV and Electron based microscopy techniques. Stereo and Inverted microscopes and their uses. Transmission, Scanning and Scanning Tunneling Microscopes.



**Section B**

Photons, LASER, Momentum of radiation, Compton effect and X-rays, Bragg's law. Project seafarer, microwave ovens, Black-body radiation and spectrum, Photons from a light bulb, Signal to noise ratio, Photomultiplier, Solar battery, Laser surgery (photocoagulation). Structure factor expression, electron density equation. The Planck's hypothesis, wave-particle duality, matter waves and de Broglie hypothesis. Principles of Spectroscopy. Energy levels, excitation, absorption, electronic, vibrational, rotational spectra. Types of spectroscopy and their uses.

Density and specific gravity, Archimedes' principle. Pressure and Buoyant force, Units of pressure, Sphygmomanometer, Gas laws, ideal gas. Avogadro's laws. Pressure, altitude and autoclaving and pressure cooking. Fluid flow, Bernoulli's principle. Viscosity and Poiseuille's law, Units of viscosity, Stoke's law. Reynold's number. Osmosis, Waves. Surface tension.

**Section C**

Radioactivity, radioactive nuclei. Physical and biological half life, handling and standardization of  $\alpha$ - and  $\beta$ -emitting isotopes. Uranium, Radium-the Curie and Plutonium, Thorium. Radioactive series, Nuclear systematics. Nuclear fission,

Breeder reactors, ecological fall outs, Biological applications. Radiolabelling, Diagnosis (Radioimmunoassay) Tracers, GM and Scintillation Counters. Therapy (Neutron activation, therapy), Radiation dose (Roentgen, Rad and Rem) and safety. Uses in molecular biology, Shielding and other precautions. Radiocarbon dating. Tritium dating.

**Books:** Physics (1988), Machlup, Wiley International Edition, John Wiley and Sons, New York

**B12. Ecology & Environmental biotechnology**

**Section A**

Basic principles of ecology. Ecosystem, population, community, succession, ecological pyramids, trophic levels, food chains, food webs, guild, productivity. Abiotic-biotic factors and their interactions. Liebig's law of minimum and Shelford's law of tolerance. Combined concept of limiting factors. Biotic – biotic interactions Adaptations: hydrophytes, halophiles, xerophiles.

Biodiversity. Measures of biodiversity and their limitations. Concept of niche and evolution of biodiversity. Information and stability of a system. Biogeochemical cycles of water, carbon, nitrogen and phosphorus.

**Section B**

Environmental Issues : Ozone hole, Global warming, El Nino, pollution, eutrophication. Biology in warning systems for environmental disturbance- Ecological indicators, biomarkers.

Liquid, solid (degradable, nondegradable, xenobiotic) and gaseous wastes.

## 26 / M.D.S.U. Syllabus / B. Sc. Biotechnology

Bioremediation. Wastewater treatment. Oxidation ponds and activated sludge process. Solid waste treatment for degradable wastes. Anaerobic treatment, composting and vermiculture. Flue gas treatment strategies.

### Section C

Resources: Renewable and non renewable. Green technologies. Fuels and their alternatives. Biofertilizers v/s fertilizers, pesticides v/s biopesticides, plastics v/s bioplastics, surfactants v/s biosurfactants, polymers (gums, adhesives, lubricants) v/s biopolymers. Production technology of *Rhizobium*, cyanobacterial biofertilizers and *Bacillus thuringiensis*. Ore leaching (biomining). Biofuels: biodiesel, petrocrops, gasohol, biogas, hydrogen production.

## B13. Cellular Interactions

### Section A

Semiochemicals: Allomones, Kairomones. Pheromones, Hormones, Allarmones. Allelochemicals. Antibiosis, antibiotics, bacteriocins. Cell-cell recognition and adhesion. Signal transduction in cells: Electrical signals, messengers and receptors.

Defense in microorganisms: Against other microorganisms, heavy metals, DNA damage and higher organisms.

### Section B

Plant defenses : unfavourable environment, hormonal regulation, drought survival, air pollution, heavy metals, infection, signaling molecules in defense. Defense in invertebrates: internal defense in molluscs, arthropods, interactions in defense.

Defense in non mammalian vertebrates: cells and tissues of immune system in fish and birds, antigen recognition, B-lymphocytes, its structure and function. Effect of temperature, stress on fish immunity.

### Section C

Mammalian defense: physicochemical barriers, Immunology. Passive, active and acquired immunity. Humoral and cell mediated immunity. Cells and organs of immune responses and their functions. Antigens Factors affecting antigenicity. Antibodies, their structure and types. Production of antibodies. Complement system. Hypersensitivity and allergic reactions.

Immunodiagnosics in Typhoid, Syphilis, Typhus fever and HIV. RIA & ELISA. Vaccines, history, types and their production strategies. Vaccines available and vaccination schedules for children. Importance of cold chain and precautions in vaccinations.

Books: Counotte A., Leach C.K., van Dam-Mieras, M.C.E. (eds) 1993. Defense mechanisms. Biotechnology by Open Learning (BIOTOL) series. Butterworth Heinemann, Oxford.

## B14. Combined practical

### Physiology

1. Internal anatomy of cockroach (dissection), ruminants and men (models).
2. Demonstration of plasmolysis using *Roheo discolor* leaves/red blood cells
3. Demonstration of osmosis by potato osmoscope
4. Estimation of chlorophyll by hot methanol extraction method
5. Estimation of photosynthetic rate using light and dark bottle method
7. Estimation of respiratory rate by Warburg method
8. Demonstration of catalase activity and peroxidase
9. Demonstration of exoenzyme activities- cellulases and amylases.
10. Demonstration of fermentation by yeast.

### Molecular Biology

1. Extraction, estimation and purification of protein from animal/microbial source by salt precipitation and organic solvent method.
2. Separation of proteins by polyacrylamide gel electrophoresis
3. Demonstration of DNA transfer by transformation and conjugation in bacteria by teaching kits.
4. Extraction of DNA from plant/animal/microbial cells.
5. Restriction digestion of DNA followed by agarose gel electrophoresis and gel documentation
6. Isolation of plasmid DNA from *Escherichia coli*

### Plant resources & Technology

1. Preparation of plant tissue culture medium: MS, Nitsche and White's media.
2. Production of callus and suspension culture
3. Isolation of plant protoplasts.
4. Plant production through tissue culture (shoot tip and nodal culture)
5. Anther culture
6. Preparation of synthetic seeds

### Biotechniques

1. Mechanical methods of cell disruption of animal/plant cells
2. Chemical methods of cell disruption of Gram negative bacteria
3. Ultrasonication to break cells of Gram positive bacteria
4. Methods of concentrating thermolabile solutions: rotary evaporator, lyophilizer.
5. Paper chromatographic separation of pigments
6. Phytochemical tests of the following: Glucose, starch, proteins, fats, tannins, ascorbic acid and anthocyanin.
7. TLC of sugars/amino acids
8. Demonstration of Beer and Lambert's law
9. Determining  $I_{\max}$  of a coloured solution

## 28 / M.D.S.U. Syllabus / B. Sc. Biotechnology

### Ecology & Environmental Biotechnology

1. Calculate diversity index of a community of plants/algae
2. Oligodynamic effect of metals on bacterial populations
3. Microscopic and macroscopic differentiation of root nodules and root galls.
4. Observing mycorrhiza.
5. Demonstration of antibiotic activity of *Penicillium* or any other organism
6. Determination of pollution in water/food using *Escherichia coli* as indicator.
7. Determination of Blood groups
8. Demonstration of precipitin test
9. Demonstration of ELISA

### B.Sc. Part III examination w.e.f - 2012

#### B15. Animal resources and Technology

**Unit I.** Chordates and non chordates. General characters of all phyla upto orders with examples emphasizing their biodiversity, economic importance and conservation measures where required. Classification, habits, habitat and features of obelia, sycon, fasciola, taenia, nereis, hirudinaria, palaemon.

**Unit II.** Classification, habits, habitat and features of Pila, lamellidens, asterias, herdmania, branchiostoma, peteromyzon, myxine. Biology of insecta. Morphology, Anatomy, life history and importance of Lepidoptera, Hemiptera, Isoptera, Orthoptera and Hymenoptera.

**Unit III.** Sericulture, Apiculture, Lac culture. Aquaculture – pisciculture, prawn and pearl culture, Vermiculture

**Unit IV.** Scope of animal tissue culture. Natural media- plasma clot, biological fluids, tissue extracts. Importance of serum. Chemically defined media. Primary culture- Cell lines, cloning disaggregation of tissue, isolation of tissue, enzymatic disaggregation and mechanical disaggregation.

**Unit V.** Secondary culture- transformed animal cells and continuous cell lines. Stem cells and their cultivation. Importance of stem cell cultivation and ethical issues involved. Production and application of monoclonal antibodies and vaccines.

#### B16. Genetic Engineering

**Unit I :** Mutations: molecular mechanism of mutations, Types of mutations (insertions, deletions, frame shift, cryptic), spontaneous and induced mutations, chemical mutagenesis with examples, Ames test, site directed mutagenesis, mobile genetic elements: Insertion elements, transposons, maize elements, Ty elements in yeast, copia elements PCR and its use in genetic engineering.

**Unit II :** Concept of cloning. Restriction enzymes their types and properties,

properties of a Cloning vehicles, plasmids as cloning vectors, viruses (phage lambda and mu) as cloning vectors, insertion of a DNA molecule into a vector, expression of cloned genes, recombinant selection and screening, genomic and cDNA libraries.

**Unit III** : Gene transfer mechanisms in bacteria: principles and application of transformation, conjugation and transduction, applications of microbial genetic engineering in biotechnology

**Unit IV** : Gene transfer mechanisms in plants. Techniques of transformation. *Agrobacterium* mediated and physical methods (microprojectile and electroporation). Applications of transgenic plants. Edible vaccines from plants.

**Unit V** : Gene transfer mechanisms in animals: Transfection of animal cell lines. HAT selection. Selectable markers and transplantation of cultured cells. Expression of cloned proteins in animal cells- expression vector, over production. T-cell cloning.

### **B17. Elementary Mathematics & Biostatistics**

**Unit I.** The language of mathematics. Priority rules of operators, The signs, Functions, Constants, variables and parameters, Dimensional analysis, plotting graphs. Exponents and Logarithms: Integer powers, Fractional exponents, Addition and subtraction of exponents, Logarithms, Common logarithms, Exponential decay, Logarithms as a method of scaling, Products of equilibrium constants, Logarithms of dimensional quantities, Redox potentials, Dependence of redox potentials on pH. Permutations and combinations, factorials.

**Unit II.** Differential Calculus: Co-ordinate geometry, Slope of a curve, Rapid differentiation, Derivatives of sums and products, Derivative of a function, Derivative of a ratio, Higher derivatives, Notation, Maxima and minima, terminology, points of inflexion, Sketching curves.

**Unit III.** Integral calculus: Increase in area, definite and indefinite integrals, simple integrals, differential equations, numerical integration: evaluating the area under curve. Solving equations: linear equations in one unknown, rearranging equations, simultaneous linear equations, determinants, quadratic equations, graphical solution of equations, Newton's method, approximate methods. Partial differentiation: Its meaning, exact and inexact differentials.

**Unit IV.** Necessity of statistics. Data, population, Errors and sampling, Descriptive and inferential statistics. Frequency distribution (Binomial, Poisson and Normal), tabulation, graphical presentation. Accuracy, precision, methods of their expression, errors, their classification, detection and correction of determinate and indeterminate errors, Normal laws of distribution of errors.

**Unit V.** Measures of central tendency and dispersion. Concepts and problems of probability. Probability of errors. Correlation, regression. Least squares fitting and its application to Michaelis-Menten equation. Hypothesis

### 30 / M.D.S.U. Syllabus / B. Sc. Biotechnology

testing: tests of significance- chi square, t-test.

**Books:** Cornish-Bowden, Athel. 1981. Basic mathematics for biochemists. Chapman & Hall, London.

#### **B18. Fermentation Technology**

**Unit I.** Growth and its requirements (environmental and nutritional). Factors affecting growth. Growth kinetics. Synchronous non synchronous, continuous and batch cultivation. Types of industrial bioprocesses (aerobic, anaerobic and light based processes, solid state and submerged fermentation).

**Unit II.** Design and parts of a fermenter (photobioreactor). Types of fermenters. Stirred tank, membrane reactors and continuous flow reactors. Maintenance of asepsis, pH, gaseous environment and temperature in a fermenter.

**Unit III.** Upstream and downstream processes. Examples of fermentations involving biomass production. Production of single cell protein and single cell oil, *Spirulina*. Separation and harvesting the desired product. Immobilization of cells and enzymes and its advantages. Bioprocesses involving extra cellular liberation of biomolecules. Production of Alcoholic beverages, penicillin, amylase. separation and harvesting of desired product.

**Unit IV.** Bioprocesses involving intracellular production of biomolecules. Production of polyhydroxyalkanoates. Separation and harvesting of desired product.

**Unit V.** Fermented foods: Yoghurt, buttermilk, idli, dosa and cheese. Strategies to reduce cost of production. Techniques to improve yield of the desired product (Strain improvement and other strategies).

#### **B19. Biotech enterprises and socioeconomic issues**

**Unit I.** Draft paper Biodiversity – Ministry of Environment & Forests and Draft paper Biotechnology-Department of Biotechnology. National Nanotechnology Initiative.

**Unit II.** Entrepreneurship in biotechnology. Funding agencies. Concepts and advantages of Biotechnological Parks and incubators. Prospecting and preparing a project report. Market survey, and decision making. Estimating the budget. Non recurring and recurring costs. Long and short term capital for the enterprise. Registering the firm with department of industries. Clearance from the department of environment, fire safety.

**Unit III.** Globalization: Concept and issues, International treaties affecting national policies related to biotechnology. Patents, Copy rights, Trade marks. Choice of IPR. Role of WTO, General Agreement of Trade and Tariffs (GATT), Trade related IPRs (TRIPS). Legal issues concerning biotechnology.

**Unit IV.** Biohazards. Biosafety guidelines and regulations. Biological contaminants. Biowaste disposal. Release of Genetically Engineered

Microorganisms in environment, its fate and fears. Ethical issues in biotechnology. Genetically modified crops (BT crops) and environmental and ethical issues.

**Unit V.** Biological warfare. Gene banks. Importance of type cultures. Cryopreservation methods. Plant cell banks, pollen banks, blood banks, sperm banks, microbial germplasm collections and international regulations.

### **B20. Emerging technologies**

**Unit I :** Bioinformatics Concept, scope and application. Biological databases. Database searches. BLAST and its relatives.

**Unit II:** Genomics. Concept, scope and application. Human Genome project. Functional genomics. DNA Microarrays.

**Unit III.** Proteomics. Concept, scope and applications. Protein classification, enzyme nomenclature. Families and superfamilies. Tools: 2-D electrophoresis, MALDI Mass spectrometry, Protein microarrays. Concept of metabolomics.

**Unit IV:** Nanotechnology and Nanobiotechnology. Concept, Scope (nanotubes, nanometals, nanoreactors, nanocomposites, nanocrystals) and application. Concept of nanotribology, nanoelectronics. MEMS.

**Unit V:** Biomimetics: Concept, scope and applications. Biomaterials and their scope in health and medicine. Trends in medical biotechnology: Genetic diseases and gene therapy. Bone marrow transplantation, artificial skin, molecular methods in diagnostics. Forensic medicine: identifying criminals using DNA fingerprinting.

### **B21. Combined Practical**

#### **Animal resources & technology**

1. Cultivation of *Daphnia*.
2. Microscopic identification of crustaceans: *Daphnia*, *Cerodaphnia*.
3. Earthworms used in vermiculture

#### **Genetic Engineering**

1. Barr bodies in buccal smears
2. Karyotype analysis in man and onion.
3. Producing auxotrophic mutants of *Escherichia coli* by chemical mutagens
4. Transfection of bacterial cells using plasmid/phage vector.

#### **Biostatistics**

Numerical exercises on precision, accuracy, randomization in experiments, tests of significance on experiments conducted earlier or being conducted.

#### **Fermentation Technology**

1. Preparing serial dilutions to count bacteria.
2. Determining growth rate of any bacteria.
3. Demonstration of diauxy in bacteria to demonstrate lac operon activity.

**32 / M.D.S.U. Syllabus / B. Sc. Biotechnology**

4. Immobilization of cells (algal/yeast cells)
5. Immobilization of enzyme (invertase may be obtained from yeast cells and observed for glucose production)
6. Production of citric acid by *Aspergillus* and its estimation.
7. Prospecting amylase producing microorganisms.
8. Preparation of yoghurt and wine
9. Estimation of alcohol by specific gravity method.

**Biotech Enterprises and socioeconomic issues**

1. Preparing a project report to begin a biotechnology based enterprise
2. Preparing a report on the biosafety and environmental safety practices being followed by any institution and pointing out deficiencies.

**Emerging technologies**

1. Elementary knowledge of biological databases. Submitting sequences on databases in public domain and practicing homology calculations.
2. Observation of slides of genetic diseases in man (Down, Turner and other syndromes) and comments on them