



YBN UNIVERSITY

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As per Section 2(f) of UGC Act. 1956

NEP-2020

BIOTECHNOLOGY COURSE / STRUCTURE

For

FOUR-YEAR UNDERGRADUATE PROGRAMMES

(FYUGP)

UNDER YBNU RANCHI JHARKHAND

Implemented in the Department of Biotechnology (School of Science)

Semester-I, II, III and IV

from

Academic Session-2023



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COURSES OF STUDY OF FOUR-YEAR UNDERGRADUATE PROGRAMME
FOR (2) YEARS-2023 onward

COURSES OF STUDY FOR FOUR YEAR UNDERGRADUATE PROGRAMME

Table 1: Course structure for Undergraduate Certificate Programme [May Exit after Sem.-II]

Semester	Common Course		Introductory Course	Major		Total credits	
Sem-I	LCS (MIL/TRL)	Understanding India	Health & Wellness, Yoga Education, Sports & Fitness	IRC-1	IVS-1A	MJ-1	
	(6Credits)	(2Credits)	(2Credits)	(3Credits)	(3Credits)	(6Credits)	(22)
Sem-II	LCS (Hindi)	Global Citizenship	Mathematical & Computational	IRC-2	IVS-1B	MJ-2	
	(6Credits)	Education (2Credits)	Thinking (2Credits)	(3Credits)	(3Credits)	(6Credits)	(22)

Total = 44 Credits

(LCS: Language and Communication Skills; MIL: Modern Indian Languages; TRL: Tribal Regional Languages; IRC: Introductory Regular Courses; IVS; Introductory Vocational Studies, MJ: Major)

Table 2: Course structure for Undergraduate Diploma Programme [May Exit after Sem.-IV]

Semester	Common Course			Introductory Course	Major	Minor	Internship/ Project	Vocational	Total credits
Sem-III	Environmental Studies	Community Engagement t/ NCC/NSS	Digital Education	IRC-3	MJ-3		Internship/ Project		
	(3Credits)	(3Credits)	(3Credits)	(3Credits)	(6Credits)			(4Credits)	
Sem-IV					MJ-4, MJ-5	MN-1		VS-1	
					(6+6=12 Credits)	(6Credits)		(3Credits)	(22)

Total=88Credits

(MN: Minor; VS: Vocational Studies)

Table 3: Course structure for Bachelor's Degree Programme**[May Exit after Sem-VI]**

Semester	Major Course	Minor Course	Vocational	Total Credits
Sem-V	MJ-6, MJ-7	MN-2	VS-2	
	(6+6=12Credits)	(6Credits)	(4Credits)	(22)
Sem-VI	MJ-8, MJ-9	MN-3	VS-3	
	(6+6=12Credits)	(6Credits)	(4Credits)	(22)

Total=132Credits**Table 4: Course Structure for Bachelor's Degree with Hons. /Research Programme**

Semester	Advance course	Research Course		Vocational	Total Credits
Sem-VII	AMJ-1, AMJ-2	Research Methodology			
		(6+6=12Credits)		(4Credits)	(22)
Sem-VIII	AMJ-3, AMJ-4	Research Int./Field Work	Research Report	VSR	
	(6+6=12Credits)	(4Credits)		(2Credits)	(22)

Total=176 Credits**(AMJ: Advance Major: VSR: Vocational Studies associated with Research)**

III	3Y4EVSC C-7	Environmental Studies	3	75	---	25	100
	3Y4CC-8	Digital Education (Elementary Computer Applications)	3	50	25	25	100
	3Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	75	---	25	100
	3Y4BTIR C-3	Introductory Regular Course-3 Introductory Biology-3	3	50	25	25	100
	3Y4BTIA P	Internship/Apprenticeship/Project	4	75	---	25	100
	3Y4BTMJ -3	Major paper-3 (Disciplinary/Interdisciplinary Major) Genetics	6	50	25	25	100
IV	4Y4BTMJ -4	Major paper-4 (Disciplinary/Interdisciplinary Major) General Microbiology	6	50	25	25	100
	4Y4BTMJ -5	Major paper-5 (Disciplinary/Interdisciplinary Major) Immunology	6	50	25	25	100
	4Y4BTM N-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) Pharmaceutical Biotechnology	6	50	25	25	100
	4Y4VS-1	Vocational Studies-1 (Minor)	4	50	25	25	100
V	5Y4BTMJ -6	Major paper-6 (Disciplinary/Interdisciplinary Major) Recombinant DNA Technology	6	50	25	25	100
	5Y4BtMJ- 7	Major paper-7 (Disciplinary/Interdisciplinary Major) Plant Biotechnology	6	50	25	25	100
	5Y4BTM N-2	Minor paper-2 (Disciplinary/Interdisciplinary Minor) Chemistry	6	50	25	25	100
	5Y4VS-2	Vocational Studies-2 (Minor)	4	50	25	25	100
VI	6Y4BTMJ -8	Major paper-8 (Disciplinary/Interdisciplinary Major) Animal Biotechnology	6	50	25	25	100
	6Y4BTMJ -9	Major paper-9 (Disciplinary/Interdisciplinary Major) Industrial Biotechnology	6	50	25	25	100
	6Y4BTM N-3	Minor paper-3 (Disciplinary/Interdisciplinary Minor) Agriculture Biotechnology	6	50	25	25	100
	6Y4BTVS -3	Vocational Studies-3 (Minor)	4	50	25	25	100

VII	7Y4BTA MJ-1	Advance Major paper-1 (Disciplinary/Interdisciplinary Major) Molecular Biology	6	50	25	25	100
	7Y4BTA MJ-2	Advance Major paper-2 (Disciplinary/Interdisciplinary Major) Bioinformatics & Nanotechnology	6	50	25	25	100
	7Y4RC-1	Research Methodology	6	75	---	25	100
	7Y4RC-2	Research Proposal	4	75	---	25	100
VIII	8Y4BTA MJ-3	Advance Major paper-3 (Disciplinary/Interdisciplinary Major) Biophysics & Bioinstrumentation	6	50	25	25	100
	8Y4BTA MJ-4	Advance Major paper-4 (Disciplinary/Interdisciplinary Major) Genetic Engineering	6	50	25	25	100
	8Y4BTRC -3	Research Internship/Field Work	4	---	---	---	100
	8Y4BTRC -4	Research Report	4	---	---	---	100
	8Y4VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credits	176				

Abbreviations:

CC	Common Course
IRC	Introductory Regular Courses
IVS	Introductory Vocational Courses
IAP	Internship/Apprenticeship/Project
VS	Vocational Studies
MJ	Major Disciplinary/Interdisciplinary Courses
MN	Minor Disciplinary/ Interdisciplinary Courses
AMJ	Advance Major Disciplinary/ Interdisciplinary Courses
RC	Research Courses
VSR	Vocational Studies associated with Research

Table 6: Semester Wise Course Code and Credits Points:

Sem.	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	Papers	Credits	Theory	Internal Assessment	Practical	Total
I	1Y4PBTMJ-1	Biochemistry & Metabilism	6	50	25	25	100
II	1Y4BTMJ-2	Cell Biology	6	50	25	25	100
III	1Y4BTMJ-3	Genetics	6	50	25	25	100
IV	1Y4BTMJ-4	General microbiology	6	50	25	25	100
	1Y4BTMJ-5	Immunology	6	50	25	25	100
V	1Y4BTMJ-6	Recombinant DND Technology	6	50	25	25	100
	1Y4BTMJ-7	Plant Biotechnology	6	50	25	25	100
VI	1Y4BTMJ-8	Animal Biotechnology	6	50	25	25	100
	1Y4BTMJ-9	Industrial Biotechnology	6	50	25	25	100
VII	1Y4BTAMJ-1	Molecular Biology	6	50	25	25	100
	1Y4BTAMJ-2	Bioinformatics & Nanotechnology	6	50	25	25	100
	1Y4BTRC-1 R	Research Methodology	6	50	25	25	100
	1Y4BTRC-2	Research Proposal	4	50	25	25	100
VIII	1Y4BTAMJ-3	Biophysics & Bioinstrumentation	6	50	25	25	100
	1Y4BTAMJ-4	Genetic Engineering	6	50	25	25	100
	1Y4 RC-3	Research Internship/Field Work	4	---	---	---	100
	1Y4 RC-4	Research Report	4	---	---	---	100
	1Y4 VSR	Vocational Studies (Associated with Research)	2	50	25	25	100
		Total Credit	98				

Table 7: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses		Examination Structure				
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I/ II/ III	IRC	Introductory Biology	3	50	25	25	100
IV	MN-1	Pharmaceutical Biotechnology	6	50	25	25	100
V	MN-2	Chemistry	6	50	25	25	100
VI	MN-3	Agriculture Biotechnology	6	50	25	25	100

Table 8: Semester wise Course Code and Credit Points:

Semester	Common, Introductory, Major, Minor, Vocational & Internship Courses						
	Code	Papers	Credits	Theory (F.M.)	Internal Assessment	Practical	Total
I	1Y4IVSOF-1A	ORGANIC FARMING – IVS-1	2	50	25	25	100
	1Y4IVSDM-1A	DIGITAL MARKETING – IVS-2	2	50	25	25	100
	1Y4IVSCM-1A	COMPUTER BASICS AND MULTIMEDIA – IVS-3	2	50	25	25	100
	1Y4IVSEWS-1A	ENGINEERING WORKSHOP-IVS-4	2	50	25	25	100
	1Y4IVSESD-1A	ENGINEERING GRAPHICS-IVS-5	2	50	25	25	100
	1Y4IVSEMC-1A	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IVS-6	2	50	25	25	100
	1Y4IVSOB-1A	ORGANIZATION BEHAVIOUR-IVS-7	2	50	25	25	100
II	2Y4IVSOF-2B	ORGANIC FARMING – IVS-1	2	50	25	25	100
	2Y4IVSDM-1B	DIGITAL MARKETING – IVS-2	2	50	25	25	100
	2Y4IVSCM-1B	COMPUTER BASICS AND MULTIMEDIA- IVS-3	2	50	25	25	100
	2Y4IVSEWS-1B	ENGINEERING WORKSHOP-IVS-4	2	50	25	25	100
	2Y4IVSESD-1B	ENGINEERING GRAPHICS-IVS-5	2	50	25	25	100
	2Y4IVSEMC-1B	ENTREPRENEURSHIP AND MANAGEMENT CONCEPTS-IVS-6	2	50	25	25	100
	2Y4IVOB-1B	ORGANIZATION BEHAVIOUR-IVS-7	2	50	25	25	100

VISION OF BIOTECHNOLOGY DEPARTMENT

The Department of Biotechnology was established in 2017, has offering quality of B.Sc., M.Sc., and Ph.D programmes in Biotechnology. This curriculum framework for the B.Sc. program in Biotechnology is developed keeping in view of the student centric learning pedagogy, which is entirely outcome-oriented and curiosity driven. The curriculum framework focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field based studies. These programmes have been designed to produce biotechnologists who can overcome the challenges and needs of the country and the world at large. Aim of this department to become a leading Centre of education, research and entrepreneurship in Biotechnology, guided by sound scientific and ethical principles. Mission of this department is to provide a vibrant learning environment, fostering innovation and creativity inspired by cutting edge research and aspire to be a national leader in developing educated contributors, career ready learners and global citizens. This department is also indulging to provide well equipped facilities for teaching, research, administration and student life and have well defined autonomous governance structure. Its clear vision to make a significant, consistent and sustainable contribution towards social, culture, education and economic life in Ranchi, Jharkhand, India.

AIMS OF BACHELOR'S DEGREE PROGRAMME IN BIOTECHNOLOGY

The objectives of the B.Sc. Biotechnology programme is to empower the students from the basics of interdisciplinary life-sciences to the recent trends in Biotechnology and its applications for the benefit of the community. The course accredits the students with conceptual and practical skills of biotechnology and introduces the students to the latest developments in biotechnology. It is fast emerging as a top course providing distinct advantages to students as it finds applications in various aspects of life sciences. The curriculum for the Biotechnology Four-Year Undergraduate Program is based on the LOCF-CBCS system of the UGC with value addition courses which are envisaged in the NEP-2020. The learning outcomes-based curriculum framework for a degree in B.Sc. (Honours) Biotechnology is intended to provide a comprehensive foundation for the subject and to help students develop the ability to successfully continue with further studies, research and startup in the subject while they are equipped with the required skills at various stages. This course serves a plethora of opportunities in different fields right from conventional to applied aspects in Biotechnology.

This platform aims at equipping the students like

- To transform curriculum into outcome-oriented scenario.
- To develop the curriculum for fostering discovery-learning.

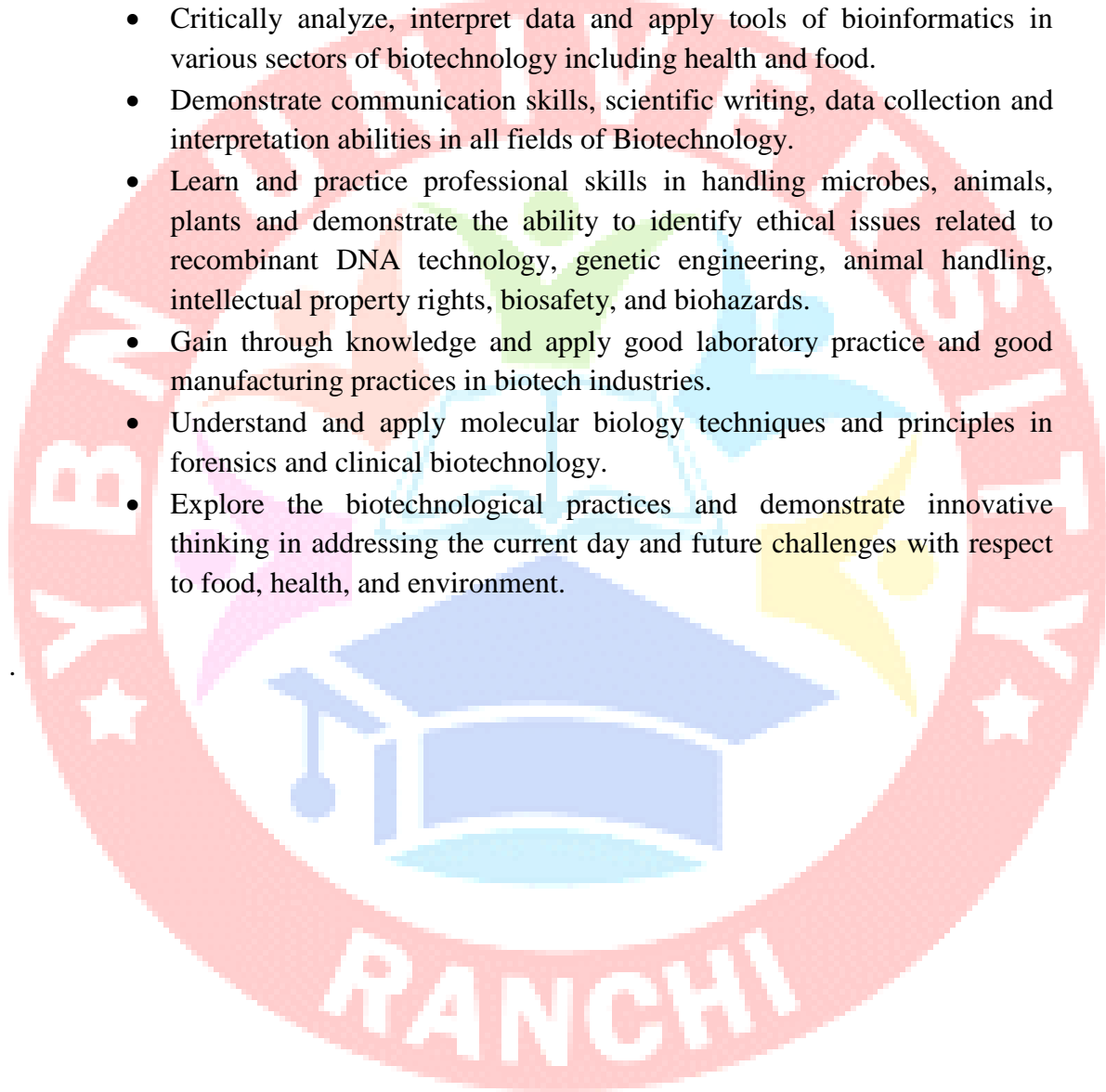
- To adopt recent pedagogical trends in education including e-learning, and MOOCs.
- To mold responsible citizen for nation-building and transforming the country towards the future.
- To emphasis on the objectively measurable teaching-learning outcomes to ensure employability of the graduates
- To equip the students with necessary scientific skills for biotechnology related careers, in Research, Industry and higher education sectors.
- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises lot more.
- It is basically a research-based subject.

PROGRAM LEARNING OUTCOMES

By the end of the program the students will be able to: -

- A detailed knowledge in the structure, function and applications of living organisms.
- Understand concepts in Biotechnology and demonstrate interdisciplinary skills acquired in cell biology, genetics, biochemistry, microbiology and molecular biology.
- Skill sets in handling microorganisms in the laboratory and their applications in academia and industry.
- Understanding and implementation of the applications of biotechnology in industry, health-care, environmental protection, food and agricultural research.
- Understanding the current trends in biotechnology and its applications. Demonstrating the ability to design, perform and interpret the experiments during the practical courses with an emphasis on technological aspects.

- Demonstrate comprehensive innovations and skills in the field of biomolecules, cell biology, molecular biology, bioprocess engineering and genetic engineering of plants, animals, microbes with respect to applications for human welfare.
- Apply knowledge and skills of immunology, bioinformatics in computational modelling of proteins, drug design and simulation to test the models and aid in drug discovery.
- Critically analyze, interpret data and apply tools of bioinformatics in various sectors of biotechnology including health and food.
- Demonstrate communication skills, scientific writing, data collection and interpretation abilities in all fields of Biotechnology.
- Learn and practice professional skills in handling microbes, animals, plants and demonstrate the ability to identify ethical issues related to recombinant DNA technology, genetic engineering, animal handling, intellectual property rights, biosafety, and biohazards.
- Gain through knowledge and apply good laboratory practice and good manufacturing practices in biotech industries.
- Understand and apply molecular biology techniques and principles in forensics and clinical biotechnology.
- Explore the biotechnological practices and demonstrate innovative thinking in addressing the current day and future challenges with respect to food, health, and environment.



B.Sc. BIOTECHNOLOGY (NEP STRUCTURE)

Four-Year (8 Semester) Full Time Degree Programme

B.Sc. Biotechnology – First Year Semester – I

Common, Introductory, Major & Vocational Courses			Examination Structure			
Code	Papers	Credits	Theory (F.M.)	Practical	Internal Assessment	Total
1Y4CC-1	Language and Communication Skills (Modern Indian Language including TRL)	6	75	---	25	100
1Y4CC-2	Understanding India	2	75	---	25	100
1Y4CC-3	Health & Wellness, Yoga Education, Sports & Fitness	2	50	25	25	100
1Y4BTIRC-1	Introductory Regular Course-1 Introductory Biology-1	3	50	25	25	100
1Y4IVS-1A	Introductory Vocational Studies-I Organic Farming-IVS-1	3	50	25	25	100
1Y4BTMJ-1	Major paper-1 (Disciplinary/Interdisciplinary Major) Biochemistry & Metabolism	6	50	25	25	100

SEMESTER-I
ENGLISH LANGUAGE & COMMUNICATION SKILLS
Course code -1Y4CC-1

Total Marks: 100

OBJECTIVE:

To equip students effectively to acquire skills in reading, writing, comprehension and communication for English language & Communication.

COURSE OUTCOMES:

- Students will improve their speaking ability in English both in terms of fluency and comprehensibility
- Students will give oral presentations and receive feedback on their performance
- Students will increase their reading speed and comprehension of academic articles
- Students will strengthen their ability to write academic papers, essays and summaries using the process approach.
- Students will enlarge their vocabulary. They will also heighten their awareness of correct usage of English grammar in writing and speaking.

Unit I:

Communication – Meaning, Types, Channels, Barriers. Skills of Language learning: Listening, Speaking, Reading & Writing.

Unit II:

English as a Global Language Growth & Status of English language in India

Unit III:

Class-presentation – Introduction, Conversation, Greetings, Likes and Dislikes, Opinion, Agreeing, Disagreeing, Complaint, Apology

Unit IV:

Writing skills –, notice writing, précis writing, essay writing, letter writing resume writing.

Unit V:

Vocabulary building: One-word substitution, synonyms and antonyms, idioms and phrases, Common Errors, Prefix, Suffix, Homophones, Confusing words

Suggested Reading:

1. *Technical Communication*, M.H. Rizvi, Tata McGrawhill
2. *Everyday Smart English*, Dr. Arti Gupta, I.D. Publishers
3. *Effective Business Communication*, Asha Kaul
4. *Developing Communication Skills*, Krishnamohan
5. *Functional Grammar and Spoken and Written Communication in English*, Bikram K. Das, Orient Blackswan
6. *Precis, Paraphrase and Summary*, P.N. Gopalkrishnan, Authors Press
7. *Communication Skills*, Sanjay Kumar and Pushplata, Oxford Publication

UNDERSTANDING INDIA

Course Code -1Y4CC-2

Total Marks: 100

Objective:

This course is designed: to expose the students to our social, economic and cultural heritage

Learning Outcome:

On successful completion of this course, the student will be able to have a knowledge regarding

1. Contemporary India with its historical perspective
2. Constitutional obligations: fundamental rights and duties.
3. Indian knowledge systems
4. India's struggle for freedom

Unit I: Background of India's culture:

1. Harappan civilisation and Vedic age
2. Buddhism, Jainism, Sanatan (Hinduism) and Islam

Unit II: Growth and development of Indian Education and literature:

1. Bharat's Natyashastra, Kalidas, Panini, Patanjali
2. Taxila, Nalanda, Vishwa Bharati, BHU, AMU, IIT, IISC, AIIMS

Unit III: Leaders of India's freedom struggle:

1. Mahatma Gandhi
2. Jawaharlal Nehru
3. Subhash Chandra Bose
4. Freedom fighters of Jharkhand (Tilka Manjhi, Sidho-Kanho, Birsa Munda & Jatra Bhaga)

Unit IV: Geographical features of India

1. India on the map of world and its neighbouring Countries.
2. Physical features of India including mountain, plateau, plain, coast, island, vegetation, rivers, soils and climate

Unit V: The People of India:

Racial diversities, Population, its growth, distribution, Migration.

Unit VI: Indian Constitution:

1. Preamble
2. Salient features
3. Fundamental rights
4. Fundamental duties

Unit VII: Political ideas:

Non-violence, Satyagraha and Social Justice

Unit VIII: The Indian Economy:

The Indian Economy through the Ages (Agriculture, Industry and Trade-Transport)

HEALTH AND WELLNESS, YOGA EDUCATION

Course Code -1Y4CC-3

Total Marks: 100

Theory: 75 Practical: 25

OBJECTIVE:

- To raise awareness towards fitness among the students.
- To develop the individual as a fit citizen in the society.
- To acquire knowledge about yoga and health & wellness.

COURSE OUTCOMES:

- Students will understand and learn different dimension of active lifestyle
- Student will learn to apply knowledge and lead better quality life
- The students will be able to continue professional courses and research in health & wellness & yoga

HEALTH AND WELLNESS

Unit1:-Introduction

1. Meaning, Definition and Dimensions of Health and Wellness.
2. Factors affecting Fitness and Wellness
3. Role of Fitness in maintaining Health and Wellness
4. Importance of Health Education and Wellness

Unit2: Methods to Maintain Health and Wellness

1. Role of Physical Activities and Recreational Games for Health and Wellness
2. Role of Yoga asanas and Meditation in maintaining Health and Wellness
- 3 Nutrition for Health & Wellness

Unit3: Anxiety, Stress and Aging

1. Meaning of Anxiety, Stress and Aging
2. Types and Causes of Stress
3. Stress relief through Exercise and Yoga

Suggested Readings:

1. Reklau Marc (2019), “30 Days: Change your habits, Change your life”, Rupa Publications, India
2. Russell, R.P.(1994).Health and Fitness Through Physical Education. USA Human Kinetics.
3. Scates Samantha (2019) “ Healthy Habits for a Healthy Life” Samantha, Ireland
3. D.M Jyoti, Yoga and Physical Activities (2015) lulu.com3101, Hillsborough, NC2 7609, United States.

YOGA EDUCATION

UNIT 1 Theory

Introduction to Health and Wellness

1. Meaning, definition and importance of Yoga
2. Types of Yoga, Introduction of Satkarma, definition of asana and Pranayama, it's physical and mental benefits
3. Stretching exercises
4. Warming up and limbering down
 - a) General warm up exercises
 - b) Specific warm up exercises

UNIT II Practical

A) Sukshma Vyayama

B) Suryanamaskara

(12 Poses are Compulsory 1. Ardhashakrasana 2.Padhashtasana 3. Ashwasanchalanasana 4. Dhandasana.5 Shasangasana 6.Astangasana7.

Bhujangasana8.Parvathasana 9. Shashangasana 10. Ashwasanchalanasana 11. Padhashtasana 12. Ardhashakrasana)

C) Basic Set of Yoga Asanas -Sitting Poses

Padmasana, Sukhasana, Vajrasana, Gomukhasana,

Prone Position.	Supine Position	Invert Position
Noka asang	Ustrasana	
Bhujangasang	Setu Bandhasana	Sarvangasana
Salabhasana	chakrasana	halasana
Marjariasana		Salambha Sarvangasana
makarasana		Sirsasana

Relaxing Pose → Shavasana

D) Basic Set of Pranayama, Meditation & Mudra

Pranayama- Anulom-Vilom Pranayama, Bhramari Pranayama, Ujjai Pranayama, Bhastrika

Pranayama, Sitali Pranayama

Meditation- Omkar meditation

Mudra – Pranav mudra, Gyan mudra, Hridaya mudra

Suggested Readings:

1. Nagendra, H.R.&Nagarathna, R. (2002).Samagra Yoga Chikitse. Bengaluru: Swami Vivekananda Yoga Prakasana.
2. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashtrothanna Prakashana
3. Shanti KY(1987)"The Science of Yogic Breathier" (Pranayama) DB Bombay
4. Iyengar B.K.S.(2006) “ Light on Yoga” Thorsons (Publ.) India

Introductory Biology-1

Course Code-1Y4BTIRC-1

Total Marks:100

Theory: 75 Practical: 25

Course Objectives:

CREDITS: 2

1. Objective of this paper is to make students aware about the diversity of plant life and their role in economical, ecological and biotechnological aspects with focus on restoration of ecosystems and sustainable development.

Course Learning Outcomes:

1. Students will be able to learn the diversity of plant kingdom and scientific nomenclature of plants. Acquaintance of students with micro to macro flora of different groups along with their utilization for human welfare.
2. They will also come to know about various plant pathogens and their integrated control methods helpful in enhancing the yield of crops and implementation of modern tools and techniques in agriculture.
3. Students will acquire knowledge about various pollutants, their ill effects on environmental health and human well-being at the same time with emphasis on control measures required for restoration of our ecosystems and sustainable development.
4. Acquaintance with ethnobotanical practices prevalent in Jharkhand and their application in keeping the environment clean and healthy as well as meeting the needs of malnutritional and anemic population.

Course Content:

Theory: 60 Lectures

- Basic Concept of Biology
- Evolution of life: Origin of Life; Darwin's concepts of evolution; Biodiversity. (lectures 4)
- Cell, the structural and functional unit of life: Three domains of life; cell types, cell organelles and structure; Basic biomolecules of cell, Cell cycle, Mitosis and Meiosis. (lectures 8)
- Nutrients, bioenergetics and cell metabolism: Essential nutrients to sustain life; biological energy and laws of thermodynamics, basics of aerobic and anaerobic glycolysis and citric acid cycle. (lectures 10)
- Genes and chromosomes: DNA, DNA replication; Central dogma of molecular biology: Transcription and translation; Mendelian Genetics; Genetic engineering/Cloning and its applications. (lectures 8)

- Biological systems: Body systems required to sustain human physiology, special sense organs including hearing, taste, smell and visual receptors. (lectures 7)
- Application of Biotechnology in Agriculture and environment. (1 lectures)
- Introductory knowledge of pollination, Fertilization and seed development in Angiosperms, Monocot and Dicot seeds; Germination of seeds. (2 lectures)
- Physiology of Plants: Ascent of Sap, Transpiration, Photosynthesis and Respiration. Fermentation- Role of microbes in food production and preservation. Biological Nitrogen fixation. (7 lectures)
- Ecology and Environment: Pond Ecosystem, Forest Ecosystem; Biogeochemical cycle – Carbon and Nitrogen. Pollution: Causes and control of air, water, soil and noise pollution; conservation of natural resources, biodiversity: definition, threats, loss and importance. Indigenous eco-friendly practices. An introduction to major global environmental issues and sustainable development. Disaster management. Peoples Biodiversity Register (PBR). (8 lectures)
- An introduction to organic farming. (2 lectures)
- Economic Botany: Food, fodder, fibre, timber, oil and pulses (2 lectures)
- Botanical Survey of India – Objectives and achievements. (1 lectures)

INTRODUCTORY BIOLOGY-3 (PRACTICAL)

CREDIT: 1

1. Study of cell and its organelles with the help of electron micrographs.
2. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
3. Study the phenomenon of plasmolysis and deplasmolysis.
4. Study the effect of organic solvent and temperature on membrane permeability.
5. Study different stages of mitosis and meiosis.
6. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
7. Determination of pH of various soil and water samples (pH meter, universal indicator/ Lovibond comparator and pH paper)
8. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
9. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
10. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
11. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
 - (a). Study of morphological adaptations of hydrophytes and xerophytes (four each).
 - (b). Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanche) Epiphytes, Predation (Insectivorous plants).

12. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
13. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
14. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
15. Field visit to familiarise students with ecology of different sites
16. Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc. Visit to a local polluted site--Urban/Rural/Industrial/Agricultural.
17. Study of common plants, insects, birds and basic principles of identification. Study of simple ecosystems--pond, river, etc.

Reference Books

1. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Ed, W. H. Freeman & Co, 2015.
2. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Ed, Macmillan Worth, 2017
3. N. Hopkins, J. W. Roberts, J. A. Steitz, J. Watson and A. M. Weiner, Molecular Biology of the Gene, 7th Ed, Benjamin Cummings, 1987.
4. C. R. Cantor and P. R. Schimmel, Biophysical Chemistry (Parts I, II and III), W.H. Freeman & Co., 1980.
5. Hall, B.K., Evolution: Principles and Processes, 1st Ed, Jones & Bartlett, 2011.

ORGANIC FARMING – IVS-1

Course Code: 1Y4IVSOF-1A

(Credits: Theory-01+ Practical 02)

Course Objectives:

Skill development of students in some identified areas of organic farming to create job opportunities in organic sector particularly in the area of organic production, on-farm resource management, input production and quality control, PGS certification and marketing of organic produce with objectives as follows:

- To create awareness about organic farming
- To produce food of high nutritional quality in sufficient quantity
- To inculcate the habit to work with natural system
- To produce food of high nutritional quality in sufficient quantity.
- To maintain and increase fertility of soil
- To use renewable resources, organic matter and nutrient elements

Course Learning Outcomes:

On successful completion of this course, the students will be able to:

- Develop critical understanding on various aspects of agronomy.
- Explain the nutrition and application of nutrients to plants.
- Explain the cropping methods and crop rotation.
- Realize various weed management practices.
- Explain the different aspects of crop harvesting.

Course Content:

UNIT- I Agronomy

1. Organic farming- concept, characteristics, significance, organic ecosystem, scope of organic farming in India
2. Principles and types of organic farming

UNIT- II Soil Science

1. Organic farming for sustainable agriculture; Manures- compost, methods of composting
2. Green manuring, vermicompost and biofertilizer

UNIT- III Fundamental of organic farm management

1. Land management in organic farming
2. Water management in organic farming

UNIT- IV Post harvest management

1. Processing, labeling of organic produce
2. Storage and transport of organic produce

ORGANIC FARMING PRACTICAL- IVS-1

Course Code: 1Y4IVSOF-1A-LAB

PRACTICALS:

60 Lectures

1. Field visit of organic farming
2. Seed and seed treatment
3. Preparation of Farm Yard Manure (FYM) & compost
4. Water management in organic agricultural

BIOCHEMISTRY AND METABOLISM

Course code-1Y4BTMJ-1

THEORY

TOTAL HOURS: 60

CREDITS: 4

Course Objective:

The course objective to provide students with a basic understanding of:

- The molecular architecture of eukaryotic cells and organelles including membrane structure and dynamics
- The principles of bioenergetics and enzyme catalysis
- The chemical nature of biological macromolecules, their three-dimensional construction and the principles of molecular recognition
- The metabolism of carbohydrates
- The principles and major metabolisms of metabolic control and of molecular signaling by hormones and the control of cell proliferation
- Study about DNA replication, organization and repair
- How genetic information in the DNA is selectively expressed as functional protein
- How genes are transmitted between generation and how, where and when errors can arise

Course Learning Outcomes:

- Through this course the students are exposed to importance of biological macromolecules
- They acquire knowledge in the quantitative and qualitative estimation of biomolecules
- They study the influence and role of structure in reactivity of biomolecules
- At the end of the course, the students have a thorough understanding on the role of biomolecules and their functions

Course Content:

UNIT I: Introduction to Biochemistry:

No. of Hours: 12

A historical prospective of Biochemistry. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their classification, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.

UNIT II

No. of Hours: 10

Carbohydrates: Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides. Homo & Hetero Polysaccharides, Mucopolysaccharides, Bacterial cell wall polysaccharides, Glycoprotein's and their biological functions.

UNIT III**No. of Hours: 14**

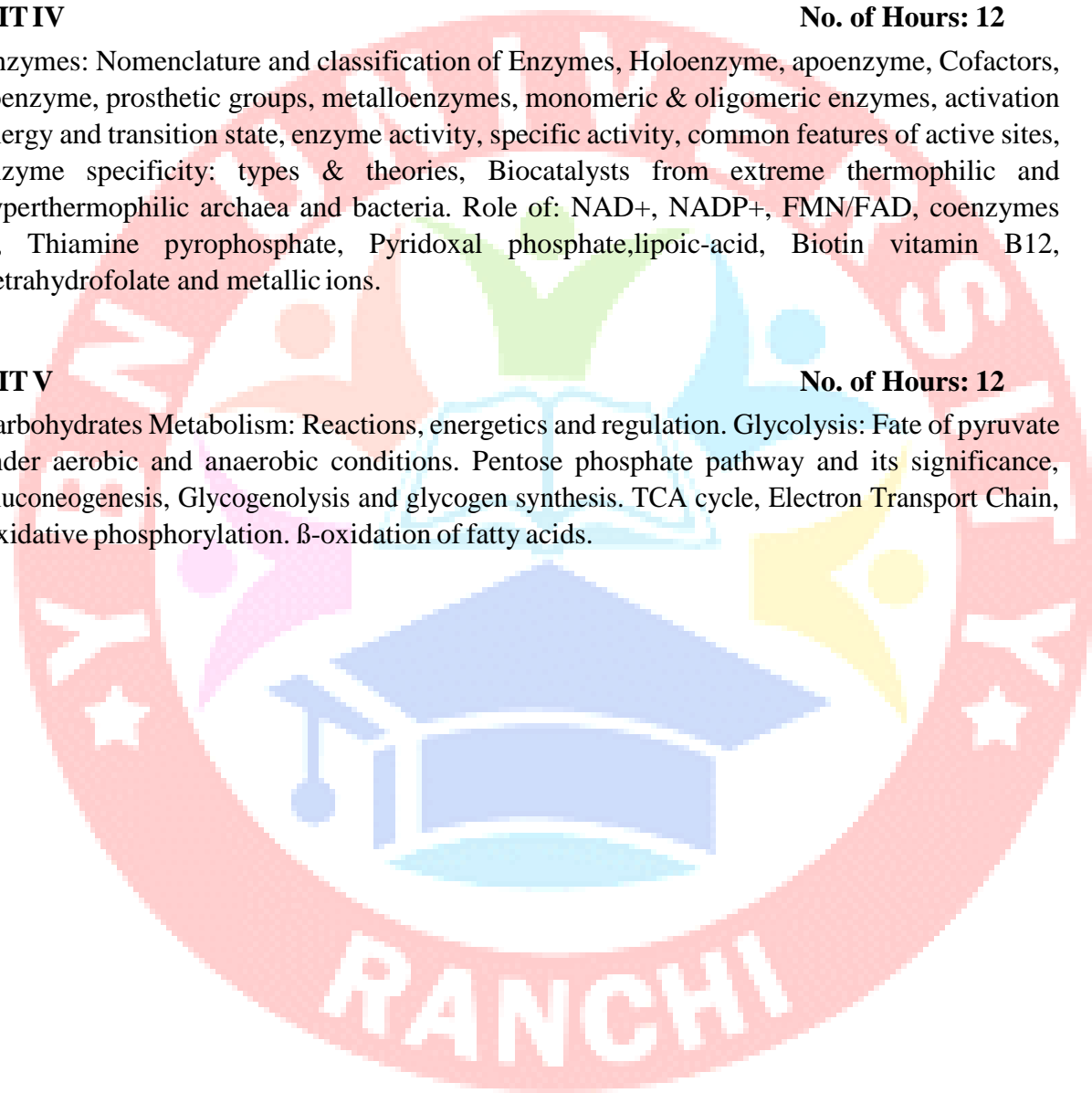
Lipids: Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol. Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines, Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA.

UNIT IV**No. of Hours: 12**

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Biocatalysts from extreme thermophilic and hyperthermophilic archaea and bacteria. Role of: NAD⁺, NADP⁺, FMN/FAD, coenzymes A, Thiamine pyrophosphate, Pyridoxal phosphate, lipoic-acid, Biotin vitamin B12, Tetrahydrofolate and metallic ions.

UNIT V**No. of Hours: 12**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation. β -oxidation of fatty acids.



BIOCHEMISTRY AND METABOLISM (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

1. To study activity of any enzyme under optimum conditions.
2. To study the effect of pH, temperature on the activity of salivary amylase enzyme.
3. Determination of - pH optima, temperature optima, Km value, Vmax value, Effect of inhibitor (Inorganic phosphate) on the enzyme activity.
4. Estimation of blood glucose by glucose oxidase method.
5. Principles of Colorimetry:
 - (i) Verification of Beer's law, estimation of protein.
 - (ii) To study relation between absorbance and % transmission.
6. Preparation of buffers.
7. Separation of Amino acids by paper chromatography.
8. Qualitative tests for Carbohydrates, lipids and proteins

SUGGESTED READING

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.
4. Hopkins, W.G. and Huner, P.A. (2008) Introduction to Plant Physiology. John Wiley and Sons.

B.Sc. BIOTECHNOLOGY (NEP STRUCTURE)

Four-Year (8 Semester) Full Time Degree Programme

B.Sc. Biotechnology – First Year Semester – II

Common, Introductory, Major & Vocational Courses		Examination Structure				
Code	Papers	Credits	Theory (F.M.)	Practical	Internal Assessment	Total
2Y4CC-4	Language and Communication Skills (Hindi)	6	75	---	25	100
2Y4CC-5	Mathematical and Computational Thinking Analysis	2	50	25	25	100
2Y4CC-6	Global Citizenship Education & Education for Sustainable Development	2	75	---	25	100
2Y4IRC-2	Introductory Regular Course-2 Introductory Biology-2	3	50	25	25	100
2Y4IVS-2B	Introductory Vocational Studies-2 Organic Farming-IVS-2	3	50	25	25	100
2Y4BTMJ-2	Major paper-2 (Disciplinary/Interdisciplinary Major) Cell Biology	6	50	25	25	100

SEMESTER-II

हिंदी भाषा

पाठ्यक्रम संख्या.2८७४

अंक: 100

इकाई-1

हिन्दीव्याकरण और रचनाए संज्ञाए सर्वनामए विशाष्टाणए क्रियाए अव्ययए कारकए वचनए सठियए उपसर्गए प्रत्ययासमासए लिंगनिर्णय शब्द लोग शब्दए अनेक शब्दों के लिए एक शब्दए शब्द-शुद्धिए वाक्य शुद्धिए मुहावरे ओर लोकोकियाए पल्लवन एवं संक्षपण।

इकाई.2

निबंधए कला तथा समसामयिक एवं राष्ट्रीय विषय पर लेखन

इकाई-3

संप्रेषण (संचार). संप्रेषण की अवधारण और महत्वए संप्रष्टाण के लिए आवश्यक शर्त संप्रेषण के प्रकारए संप्रेषण की तकनीकए वाचनकलाए समाचारवाचनए साक्षात्कारकलाए रचनात्मक लेखनका लक्ष्यए रचनात्मक लघु का आधारए भारत की भाव और विचारो की प्रस्तुतिए वाक कला की उपयोहगता।

अनुशंसितपुस्तकें :-

रूहतव्याकरणभास्कर े डे ० र्चनद कुंमार

□□हं तहनबधेे् ाभास्कर डे० र्चनदर् कु मार

□□आधुहनकहहन्दीव्याकरणऔररचना े डे ० र्ासुद र्न्दनप्रसाद

□□रचनामानस े प्रो० राम श्वरनाथहतरारी

□□व्यर्हररकहहन्दी े डे ० जंग बहादुरपाण्ड य

□□रचनात्मक खन े डे ० रमशेेेागौतम

□□राजहंसहहन्दीहनबंध े प्रो० आर० एन० गौड़

□□सफ हहन्दीहनबंध े रत्न श्वर

□□हनबंध सहचर े डे ० क्ष्मणप्रसाद

□□ उपकारमहार् और ाक ोहियाँ े पार् ० राज श्वरप्रसादचतवर्ु दी

□□ कहाहनयोँकहाती की े प्रतापअनम

□□ सम्प्र षणपरकहहन्दीभाषाहशक्षण डारे ० रैश्रानारंग

□□ शैीहर्ज्ञान े डारे ० सुर शकुमार

□□ शैीहर्ज्ञानप्रहतमानऔरहर्शल षण डारे ० पाडं य शहशभषे ूेाण श्शीताशेँ् ोे“ु

□□ शैीहर्ज्ञानकाइहतहास े डारे ० पाडं ेय शहशभषे ूेाण श्शीताशेँ् ोे“

MATHEMATICAL AND COMPUTATIONAL THINKING AND ANALYSIS

Course code-2Y4MCTCC-5

Total Marks: 100

Course Learning Outcomes: This course will enable the students to:

- Understand the notions of logic and Mathematical Induction.
- Basic concepts of sets.
- Analytic approach toward the solution of algebraic equations.
- Connections of roots and coefficients.
- Understand basic concept of Probability and statistics.
- Understand and analyze the coordinate systems.

UNIT-1: Logic: statement, truth table, quantifiers, connectives and tautology, Mathematical induction.

UNIT-2: Sets and Number System: operations on sets, Elementary Properties, Decimal system, binary decimal, octal system, hexadecimal system, arithmetic, conversion from binary to decimal and decimal to binary.

UNIT-3: Theory of Equation: Relation between roots and coefficients, Transformation of equation, Symmetric functions of roots, Solutions of cubic and biquadratic equations.

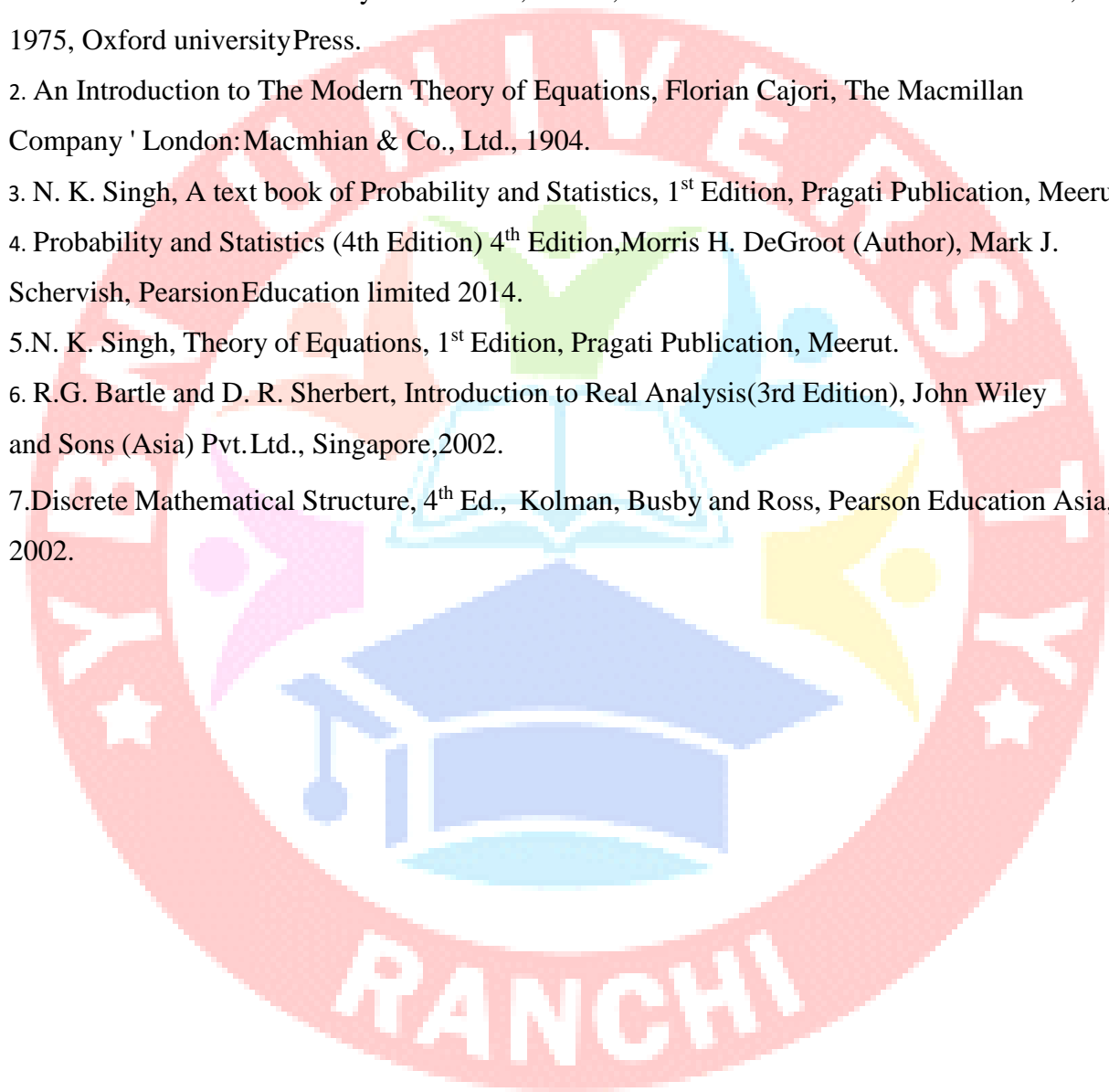
UNIT-4: Statistics and Probability: Data collection and presentation using bar chart, column chart, line chart, pie chart, scatter chart, surface chart. Calculation of frequency. Measure of central tendency, Mean, Median and Mode, Definition of Probability,

Elementary properties, addition theorem, multiplication theorem, independent events.

UNIT-5: Geometry: Cartesian, spherical polar and Spherical cylindrical coordinate systems; their interrelationship.

Suggested reading:

1. An introduction to the theory of Numbers, 4th Ed., G. H. HARDY AND E. M. WRIGHT, 1975, Oxford university Press.
2. An Introduction to The Modern Theory of Equations, Florian Cajori, The Macmillan Company ' London: Macmillan & Co., Ltd., 1904.
3. N. K. Singh, A text book of Probability and Statistics, 1st Edition, Pragati Publication, Meerut.
4. Probability and Statistics (4th Edition) 4th Edition, Morris H. DeGroot (Author), Mark J. Schervish, Pearson Education limited 2014.
5. N. K. Singh, Theory of Equations, 1st Edition, Pragati Publication, Meerut.
6. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
7. Discrete Mathematical Structure, 4th Ed., Kolman, Busby and Ross, Pearson Education Asia, 2002.



**GLOBAL CITIZENSHIP EDUCATION & EDUCATION FOR SUSTAINABLE
DEVELOPMENT**

Course code-1Y4CC-6

Total Marks: 100

OBJECTIVE:

- To understand the concept and structure of global governance
- To empower learners to become aware of and understand global and sustainable development issues
- To become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies.
- Enabling students to embrace and practice constitutional, humanistic, ethical, and moral values in conducting one's life, including universal human values and citizenship values.
- To practice responsible global citizenship required for responding to contemporary global challenges

COURSE OUTCOMES:

- Enhance the capacity of the learners to acquire and demonstrate problem-solving skills involving the capacity to solve different kinds of problems in familiar and unfamiliar contexts and apply one's learning to real-life situations.
- Creativity characterized by the ability to create or think in different and diverse ways, deal with problems and situations that do not have simple solutions; view a problem or a situation from multiple perspectives; think 'out of the box' and generate solutions to complex problems in unfamiliar contexts.
- Communication Skills characterized by skills that enable a person to present complex information in a clear and concise manner to different groups/audiences; express thoughts and ideas effectively in writing and orally and communicate with 3 others using appropriate media, convey ideas, thoughts and arguments using language that is respectful and sensitive to gender and social groups.

UNIT 1: Global Citizenship Education(GCE) and Education for Sustainable Development

1. Global Citizenship Education; its meaning, characteristics, scope and subject –matter emergence and development.
2. Rights and responsibilities of Global citizenship
3. Benefits, Importance and theories of Global Citizenship
4. Global governance – concept and structure
5. Global Citizenship: (a) General idea, (b) Multi cultureless & diversity, (c) tolerance &(d) Acharya Vinoba’s ideas of ‘Jai Jagat.’

UNIT2: Global Poverty, Inequalities and social change

1. Concept of Global Poverty and its impact on World economy
2. concept of social change, its types and theories.
3. Human Right Education: Special reference to Universal Declaration of Human Rights, 1943
4. Concept of Peace and Security: Special reference to United Nations Charter

UNIT 3: Sustainable Development – Global Issues and Sustainable Issues

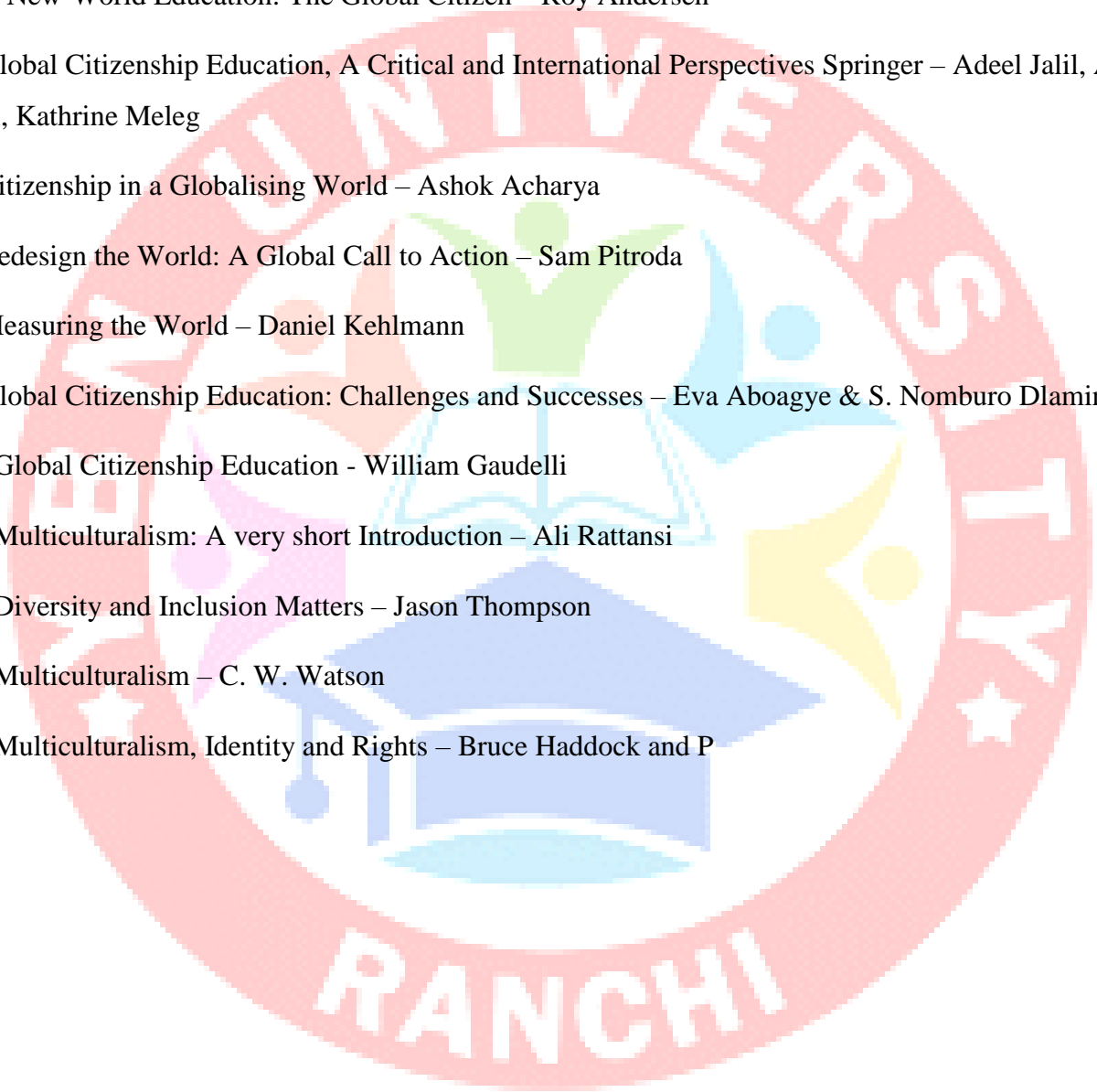
1. Global environment Issue-Climate change mitigation and adaptation
2. Sustainable Development: Brief overview
3. Biodiversity loss, Global warming and carbon emission
4. Effect of Global Issue on Human Species
5. Environmental justice

UNIT 4: Citizenship Education & Culture, Globalization

1. Gender equality
2. Meaning of Globalization and its impact of world economy
3. Meaning of culture, crucial factors in the Globalization of culture

Suggested Readings:

1. Global Politics – Rupak Dattagupta
2. Understanding Global Politics – Chanchal Kumar
3. Global Citizenship Education for Young Children – Robin Elizabeth Hancock
4. A New-World Education: The Global Citizen – Roy Andersen
5. Global Citizenship Education, A Critical and International Perspectives Springer – Adeel Jalil, A.K. Kari, Kathrine Meleg
6. Citizenship in a Globalising World – Ashok Acharya
7. Redesign the World: A Global Call to Action – Sam Pitroda
8. Measuring the World – Daniel Kehlmann
9. Global Citizenship Education: Challenges and Successes – Eva Aboagye & S. Nomburo Dlamini
10. Global Citizenship Education - William Gaudelli
11. Multiculturalism: A very short Introduction – Ali Rattansi
12. Diversity and Inclusion Matters – Jason Thompson
13. Multiculturalism – C. W. Watson
14. Multiculturalism, Identity and Rights – Bruce Haddock and P



INTRODUCTORY BIOLOGY-2

Course Code-1Y4BTIRC-2

THEORY

Total Marks:100

Theory: 75 Practical: 25

Course Objectives:

CREDIT: 2

1. Objective of this paper is to make students aware about the diversity of plant life and their role in economical, ecological and biotechnological aspects with focus on restoration of ecosystems and sustainable development.

Course Learning Outcomes:

1. Students will be able to learn the diversity of plant kingdom and scientific nomenclature of plants. Acquaintance of students with micro to macro flora of different groups along with their utilization for human welfare.
2. They will also come to know about various plant pathogens and their integrated control methods helpful in enhancing the yield of crops and implementation of modern tools and techniques in agriculture.
3. Students will acquire knowledge about various pollutants, their ill effects on environmental health and human well-being at the same time with emphasis on control measures required for restoration of our ecosystems and sustainable development.
4. Acquaintance with ethnobotanical practices prevalent in Jharkhand and their application in keeping the environment clean and healthy as well as meeting the needs of malnutritional and anemic population.

Course Content:

Theory: 60 Lectures

UNIT I

Introduction to biotechnology: Origin and definitions, history of biotechnology ancient, classical and modern, major scientific discoveries in biotechnology, an interdisciplinary activity-strain choice, mass culture, optimization of cell responses, process of operations, product recovery. Scope and importance, commercial potential. Biotechnology in India and its global trends, Major biotechnology institutes and companies in India.

UNIT II

DNA fingerprinting, cloning (DNA cloning, animal cloning), Transgenic plants and animals, in vitro fertilization, artificial insemination, artificial insemination, stem cell technology.

UNIT III

Biotechnology and its application: Applications of biotechnology in Agriculture, medicine, environment, veterinary sciences, food industry, chemical industry, pharmaceutical industry forensic science; Bioremediation and waste treatment biotechnology

UNIT IV

Emerging fields of biotechnology: Nano biotechnology, bioinformatics, pharmacogenomics, regenerative medicine, therapeutic proteins, bio-robotics, biosensors; Brief account of safety guidelines and risk assessment in biotechnology; Ethical issues related to biotechnology.

INTRODUCTORY BIOLOGY (PRACTICALS)

CREDITS:1

1. Basic operations in laboratory
2. Documentation: The Lab Notebook & Lab Report
3. Biotechnology Laboratory Security & Safety
4. Lab Equipment & Reagent Orientation
5. Math Skills for the Laboratory
6. Basic tools in the biotechnology laboratory
7. Calibrating Lab Instruments
8. Preparing solutions

SUGGESTED READING: *(All the books should be of the latest edition/version)*

1. Mathuriya A S. *General introduction to biotechnology Industrial Biotechnology* (New Delhi: Ane Books Pvt) p 2
2. *Biotechnology: Progress and Application* by [Saif Hameed](#)
3. Hulse JH. *Biotechnologies: Past history, present state and future prospects.* Trends Food Sci Technol
4. Wohlgemuth R. *Industrial biotechnology – past, present and future.* New Biotechnology
5. *Biotechnology Fundamentals and Application* by S. S. Purohit Ex-Head, P.G. Department of Botany Dungar College, Bikaner.
6. Seidman & Moore, *Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference,*
7. *Laboratory security:* <http://ehs.uky.edu/ohs/labsecurity.html>
8. *Molecular Biology Problem Solver* edited by Alan S. Gerstein
9. *Basic Laboratory Methods for Biotechnology,* by Lisa A. Seidman & Cynthia J. Moore. Prentice Hall

ORGANIC FARMING – IVS-2
Course Code: 2Y4IVSOF-2B

(Credits: Theory-01 + Practical 02)

Theory: 15 Lectures

Course Content:

UNIT- I Agronomy

1. Choice of crops & varieties in organic farming
2. Initiative by Govt/NGOs/Other organizations for promotion of organic farming

UNIT- II Soil Science

1. Harmful effect of non-judicious chemical fertilization
2. Organic farming practices for improving soil health

UNIT- III Fundamental of organic farm management

1. Organic insect disease management
2. Organic pest disease management

UNIT- IV Post harvest management

1. Organic Quality control standards
2. Certification- types, process & procedure and agencies

ORGANIC FARMING PRACTICAL- IVS-1

Course Code: 2Y4IVSOF-2B-LAB

PRACTICALS:

60 Lectures

1. Crop planning & management in organic agriculture
2. Identification of different fungal and bacterial biocontrol agents
3. Application of manures and composts
4. Preparation of plant protection inputs Periods
5. Application of plant protection inputs

CELL BIOLOGY

Course code: 2Y4BTMJ-2

THEORY

TOTAL HOURS: 60

CREDITS: 4

Course Objectives:

1. Objective of this paper is to make students aware about the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. Students will understand how these cellular components are used to generate and utilize energy in cells.
3. Students will understand the cellular components underlying mitotic cell division.
4. Students will apply their knowledge of cell biology to selected examples of changes or losses in cell function. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Course Learning Outcomes:

Students will have the knowledge and skills to:

1. Describe the evolution, diversity and replication of cells
2. Explain the role of compartmentalization and signalling in cellular biology
3. Interpret and explain key experiments in the history of cell biology
4. Evaluate and apply knowledge of modern techniques in cellular biology
5. Interpret, analyse, describe and present new experimental data.

UNIT I

No. of Hours: 12

Cell: Introduction and classification of organisms by cell structure, cytosol, compartmentalization of eukaryotic cells, cell fractionation.

Cell Membrane and Permeability: Chemical components of biological membranes, organization and Fluid Mosaic Model, membrane as a dynamic entity, cell recognition and membrane transport.

UNIT II

No. of Hours: 13

Membrane Vacuolar system, cytoskeleton and cell motility: Structure and function of microtubules, Microfilaments, Intermediate filaments. Endoplasmic reticulum: Structure, function including role in protein segregation. Golgi complex: Structure, biogenesis and functions including role in protein secretion.

UNIT III**No. of Hours: 13**

Lysosomes, Vacuoles and microbodies: Structure and functions Ribosomes: Structures and function including role in protein synthesis. Mitochondria: Structure and function, Genomes, biogenesis. Chloroplasts: Structure and function, genomes, biogenesis Nucleus: Structure and function, chromosomes and their structure.

UNIT IV**No. of Hours: 12**

Extracellular Matrix: Composition, molecules that mediate cell adhesion, membrane receptors for extracellular matrix, macromolecules, regulation of receptor expression and function. Signal transduction.

UNIT V**No. of Hours: 10**

Cancer: Carcinogenesis, agents promoting carcinogenesis, characteristics and molecular basis of cancer.



CELL BIOLOGY (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

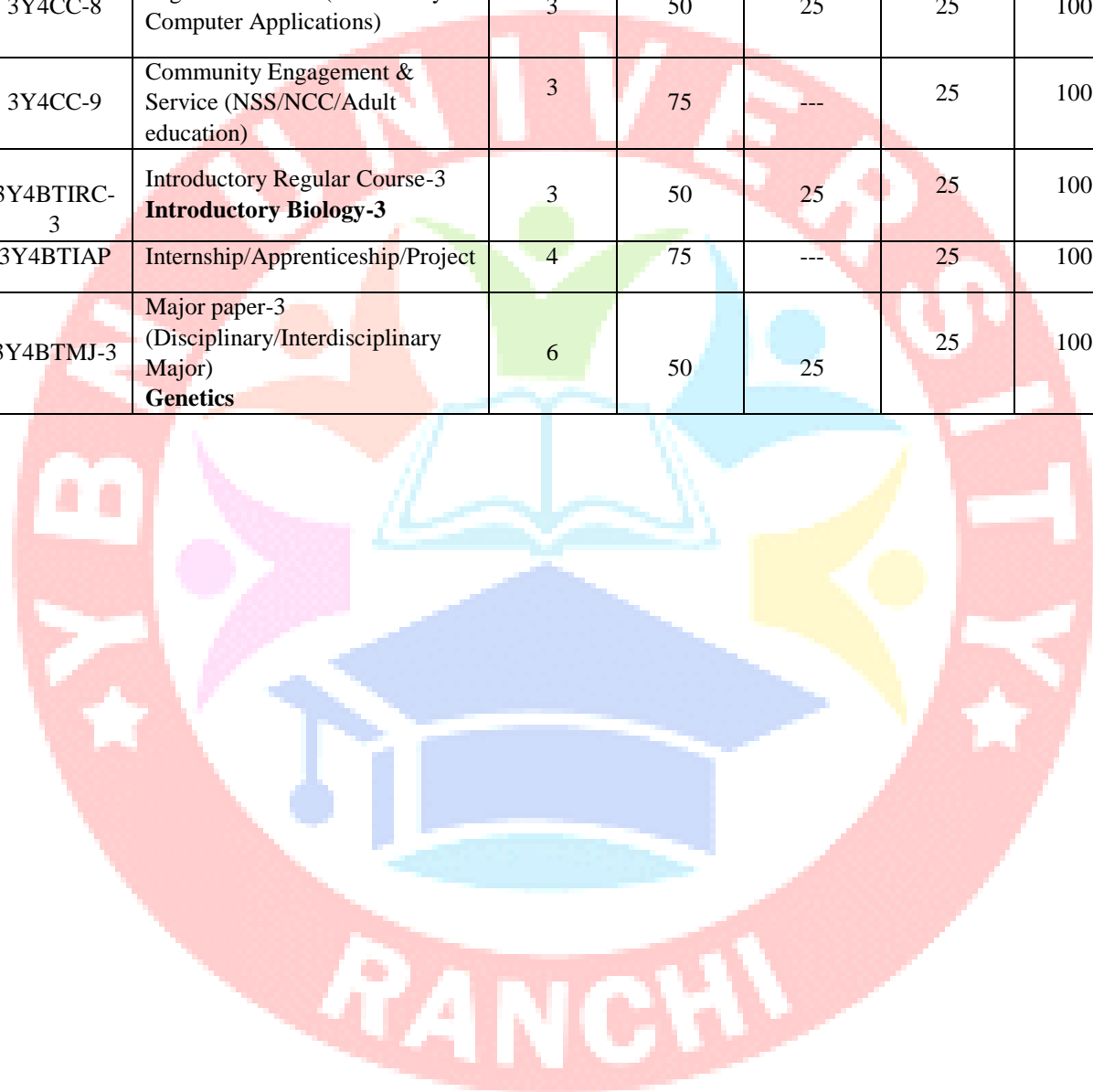
1. Study the effect of temperature and organic solvents on semi permeable membrane.
2. Demonstration of dialysis.
3. Study of plasmolysis and de-plasmolysis.
4. Cell fractionation and determination of enzyme activity in organelles using sprouted seed or any other suitable source.
5. Study of structure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

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

B.Sc. BIOTECHNOLOGY (NEP STRUCTURE)
 Four-Year (8 Semester) Full Time Degree Programme
B.Sc. Biotechnology – Second Year Semester – III

Common, Introductory, Major & Internship Courses			Examination Structure			
Code	Papers	Credits	Theory (F.M.)	Practical	Internal Assessment	Total
3Y4EVSCC-7	Environmental Studies	3	75	---	25	100
3Y4CC-8	Digital Education (Elementary Computer Applications)	3	50	25	25	100
3Y4CC-9	Community Engagement & Service (NSS/NCC/Adult education)	3	75	---	25	100
3Y4BTIRC-3	Introductory Regular Course-3 Introductory Biology-3	3	50	25	25	100
3Y4BTIAP	Internship/Apprenticeship/Project	4	75	---	25	100
3Y4BTMJ-3	Major paper-3 (Disciplinary/Interdisciplinary Major) Genetics	6	50	25	25	100



SEMESTER-III

ENVIRONMENTAL STUDIES

Course Code: 3Y4CC-7

Theory: 55 Lectures

Course Objectives:

The course will seek to achieve the following objectives:

1. Generating the awareness about environmental problems among people and society.
2. To clarify modern environmental concept like how to conserve biodiversity.
3. Inculcating basic knowledge about the environment and its allied problems.
4. Developing an attitude of concern for the environment.
5. Motivating public to participate in environment protection and environment improvement.
6. Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
7. Striving to attain harmony with Nature.

Course Learning Outcomes:

At the end of the course students will be able to:

1. Know the more sustainable way of living.
2. Use natural resources more efficiently.
3. Know the behaviour of organism under natural conditions.
4. Know the interrelationship between organisms in populations and communities.
5. Aware and educate people regarding environmental issues and problems at local, national and international levels.

Course Content:

Unit 1: Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development. (2 lectures)

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
 - a) Forest ecosystem
 - b) Grassland ecosystem
 - c) Desert ecosystem
 - d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(8 lectures)

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

(10 lectures)

Unit 4: Biodiversity and Conservation

- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

(10 lectures)

Unit 5: Environmental Pollution

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies.

(9 lectures)

Unit 6: Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

(10 lectures)

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g. CNG vehicles in Delhi).

(6 lectures)

Environment Studies Field Work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted Site-Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems-pond, river, Spring, etc.

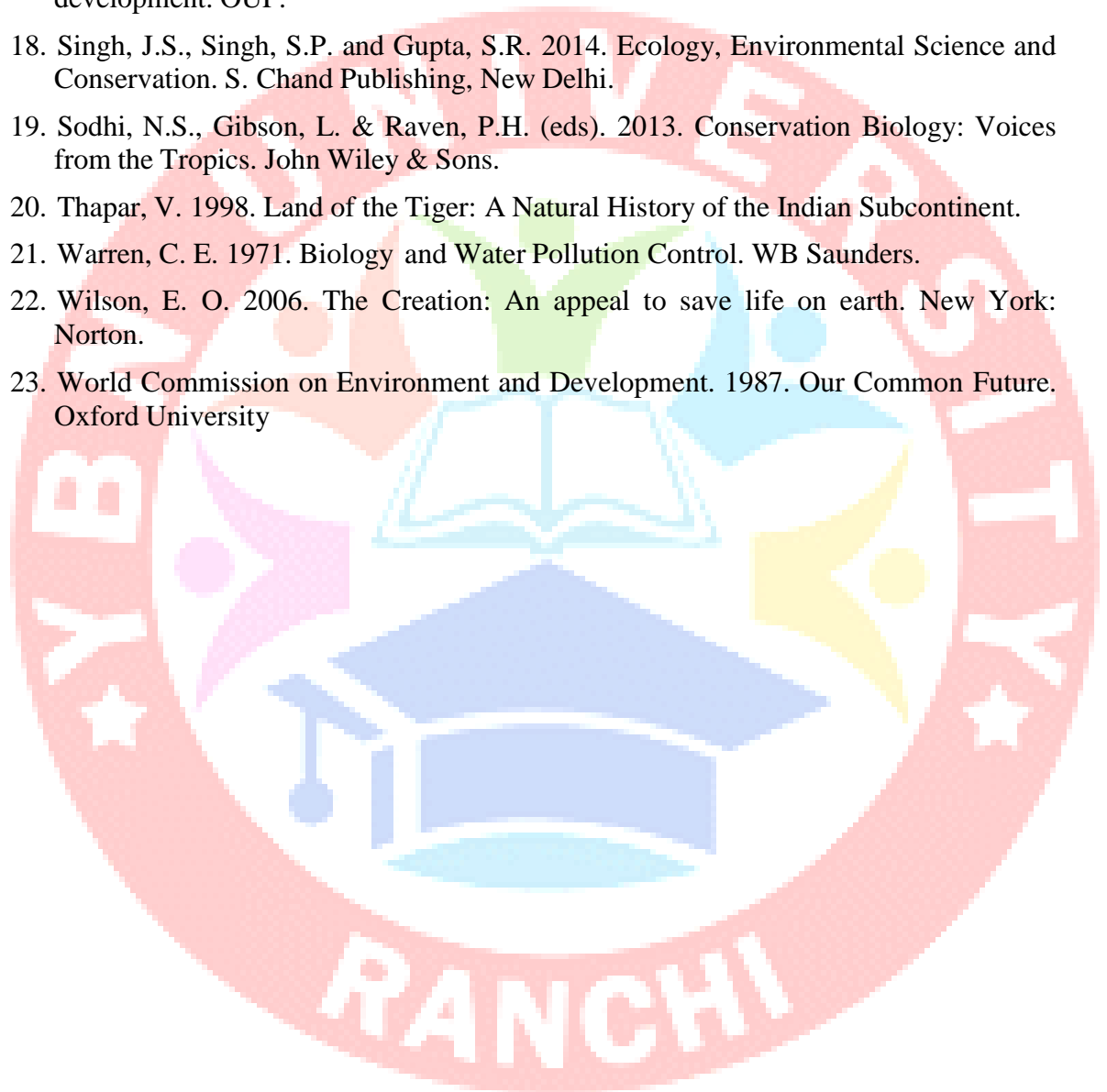
(Equal to 10 lectures)

References:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., & Guha, R. 1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Press.
4. Gleeson, B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.
5. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
6. Room, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology.
7. Sunderland: Sinauer Associates, 2006.
8. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36-
9. 37.
10. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
11. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
12. Odum, E.P., Odum, H.T. & Andrews, J. 1971. Fundamentals of Ecology. Philadelphia: Saunders.
13. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution

Science. Academic Press.

14. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
15. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.
16. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.
17. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
18. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
19. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
20. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
21. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
22. Wilson, E. O. 2006. The Creation: An appeal to save life on earth. New York: Norton.
23. World Commission on Environment and Development. 1987. Our Common Future. Oxford University



Digital Education (Elementary Computer Application)
Course code: 3Y4DECC-8

CREDITS: 03

Course Objectives:

This course is specially designed for better understanding of digital education in India. The course has been designed to introduce key concepts in digital education to the students to sharpen their understanding of importance and significance of digital education in India. The students need to develop a critical thinking about the development of India in the background of expanding digital networks and our constant dependence on them in our day-to-day life.

Learning Outcome

- Students will understand the meaning of digital education and its importance.
- They will be able to focus on different digital platform, its utility and its applications.
- The students will be exposed to different tools of digital education available in India.
- They will understand the importance of E-Learning in the changing context of Digital India.
- They will come to know about their responsibility as citizen in digital growth in India.

UNIT I: Introduction to Digital Education

5

Classes Meaning & Evolution of Digital Systems. Role & Significance of Digital Technology, digital education vs traditional education, advantages and disadvantages of digital education.

UNIT II: Digital Education Tools (10 Classes+ 5 Hands on Sessions)

Information & Communication Technology & Tools

Interactive tools- Microsoft Teams, Google Classroom, LinkedIn

Creative Tools - Google Slides, Google Spreadsheets, Google form, Youtube)

UNIT III: Digital Education in India (10 Classes + 5 Hands on Sessions)

Government initiatives for Digital education in India: SWAYAM, E-Pathshala, National digital library of India (NDL India), DigiLocker. Advantages & challenges in digital education in India.

**UNIT IV: E- Governance
Classes)**

10

Introduction of E-Governance in India, Types of E-Governance-G2C (Government to Citizen), G2E (Government to Employee), G2B (Government to Business), G2G

(Government to Government), E – Governance in Jharkhand.

Suggested Readings:

1. E-Governance in India: Initiatives and issues by R.P.Sinha
2. Information & Communication Technology (ICT) in Education by Dr. Vanaja M, Dr. S Rajasekar, Dr. S. Arulsamy.
3. Digital India: Understanding Information, Communication and Social Change by Pradip N.

References:

1. www.slideshare.net
2. www.lisportal.com/en/lis-blog



COMMUNITY ENGAGEMENT NCC/NSS

Course code (1Y4CC-6)

Total Marks: 100

Course Objectives

Understand the community in which they work and their relation, Identify the needs and problems of the community and involve them in problem-solving, develop capacity to meet emergencies and natural disasters, Practice national integration and social harmony and, utilize their knowledge in finding practical solutions to individual and community problems.

Course Outcomes

To impart hands-on skills in preparation, In the end of the paper, a student should be able to: - Understand the importance of having community problems and their solutions. It might help in job opportunities in some government approved NGOs, and ministry of youth affairs and sports. The students can carry out basic information about the community, which in turn will be of great help in disaster management fields. Students can also go for social community courses, opening opportunities in different social activity related departments.

Unit-I: NSS:

Introduction, Origin and growth of NSS, Objectives, Motto, Symbol, NSS, Import National Days, NSS Song, Environmental Awareness: Natural Resources – Conservation and Management, Water conservation and Rain water harvesting, Solid waste management, Pollution control: Water, Air, Noise and Soil; Energy conservation- Wildlife Conservation, Global warming.

Unit-II: Special Programme:

Legal Awareness – Health awareness –Blood Donation Camp, First –Aid –Career Guidance – Leadership. Training cum –Cultural Programme –Globalization ant its Economic Social and Cultural Impacts. Planning and Preparation of special Camping Programme. Planning at institutions level – Guidelines for the success of camp- Importance of successful camping programme – Guiding principles – organization of camp – Administration of camp.

Unit-III: Social Awareness:

Basics and Social Service, Weaker Section of our society and their needs – NGOs: Role and Contribution –Civic responsibility – causes and Prevention; role of y uth –Drug Abuse and Trafficking –awareness of IV / AIDS. National Integration: Impo tance and Necessity – Freedom Struggle and Nationalistic movement in India – National interests, Objectives, Threats and Opportunities – Unity in Diversity – Contribution of

Youth in Nation Building.

Unit-IV: First Aid:

Artificial Respiration – Control of Bleeding – Fractures – Burns – Shock – Wounds – Eye Injuries – Heat Stroke – Snake Bite – Dog Bites – Poisoning., Disaster Management: Characteristics and types of Disasters (Geological and Mountain Area Disaster, Wind and Water Related natural Disaster, Man-made Disaster) , Causes and effects, Assistance during Natural / Other Calamities
Flood / Cyclone / Earth Quake / Accident etc.

Unit-V: N.S.S. Regular Activities

NSS Programme Officer – NSS Volunteer – Community – Aims of NSS Programme /Activities – Classification of NSS Programme – Adoption of Villages – Contacting Villages / Area Leaders – Survey of the Villages / Area Identification of Problem(s) Completion of Projects – Evaluation of Project – Adoption of Slums – Survey of the Slum – Services in Slums - Coordination with Voluntary – Organizations.

REFERENCES:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. Avhan Chancellor's Brigade-NSS Wing, Training camp on Disaster Preparedness Guidelines, March 2012.
4. Rashtriya Seva Yojana Sankalpana- Prof. Dr. Sankay Chakane, Dr. Pramod Pabrekar, Diamond Publication, Pune.
5. National Service Scheme Manual for NSS District Coordinators, National Service Scheme Cell, Dept. of Higher and Technical Education, Mantralaya,
6. Annual report of National Service Scheme (NSS) published by Dept. of Higher and Technical Education, Mantralaya,
7. NSS Cell, Dept. of Higher and Technical Education, Mantralaya, UTKARSHA- Socio and cultural guidelines.
8. Case material as a Training Aid for Field Workers, Gurmeet Hans.
9. Social service opportunities in hospita's, Kapil K. Krishnan, TISS
10. New Trends in NSS, Research papers published by University of Pune.
11. ANOOGUNJ Research Journal, published by NSS Unit C. K. Thakur college
12. Training Manual for Field Work published by RGNIYD, Shreeperumbudur
13. Prof. Ghatole R.N. Rural Social Science and Community Development.
14. Purushottam Sheth, Dr. Shailaja Mane, National Service Scheme

Related Online Contents:

1. <https://en.wikipedia.org/w/index.php?search=National-service-scheme&title=Special%3ASearch&fulltext=1&ns0=1>

2. <https://nss.gov.in>
3. <https://twitter.com/nssybnuranchi1>
4. <https://twitter.com/nssybnuranchi2>
5. <https://www.facebook.com/profile.php?id=100083943787477>

Introductory Biology-3

Course Code-1Y4BTIRC-3

Total Marks:100

Theory: 75 Practical: 25

Course Objectives:

- to demonstrate significant cell biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology and genetics into practical understanding.
- Competent in applying theoretical and practical hands on approach in Biotechnology.
- To apply the knowledge in providing solution to health, environmental and research problems.
- Promote Innovation and Research in cutting edge biotechnological research.
- To address the problems faced by India and to become a responsible citizen.
- Promote a strong sense of team spirit and brotherhood for building a strong India.

Course Learning Outcomes:

The graduates of Biotechnology student must have:

- Ability to approach, analyze and bring out scientific solution for a given problem.
- Knowledge to implement multidisciplinary concepts and ideas for the development of innovative technologies.
- Expertise to demonstrate leadership, quality and entrepreneurship.
- Demonstrate technical skills in operation and maintenance of sophisticated instrumentations.
- Intelligence to protect their innovative research through IPR.
- Innovation for high quality research on par with international laboratories.
- Expert to explore scientific projects for need based industry.
- Capability to bring out good quality research proposal as well as research publications.

- Student would be competent discipline-specific studies, as well as to begin domain-related employment.
- To mould a responsible citizen who is aware of most basic domain-independent knowledge, including critical thinking and communication.

Course Content:

THEORY

(CREDITS 2)

(Lectures =60)

Unit 1: Nerve and muscle

Structure of a neuron, resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction 8 Lectures

Unit 2: Digestion

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids 5 Lectures

Unit 3: Respiration

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood 5 Lectures

Unit 4: Excretion

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism 5 Lectures

Unit 5: Cardiovascular system

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle 6 Lectures

Unit 6: Reproduction and Endocrine Glands

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal 7 Lectures

Unit 7: Carbohydrate Metabolism

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain 5 Lectures

Unit 8: Lipid Metabolism

Biosynthesis and β oxidation of palmitic acid 5 Lectures

Unit 9: Protein metabolism

Transamination, Deamination and Urea Cycle

5 Lectures

Unit 10: Enzymes

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

6 Lectures

PRACTICAL

(CREDITS 1)

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
5. Estimation of total protein in given solutions by Lowry's method.
6. Study of activity of salivary amylase under optimum conditions

SUGGESTED READINGS

Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.

Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill

Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B.

Saunders Company Berg, J. M., Tymoczko, J. L and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.

Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.

Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

Internship/Apprenticeship/Project

Course Code: 3Y4BTIRC-3

Course Objectives:

- Project-based learning and action research are powerful pedagogies in improving science education.
- The objective of this project is to provide students with the opportunity to develop problem solving and critical thinking skills, collaboration, and problem solving skills in the context of content-based knowledge that influences comprehension and academic self-confidence.
- Project / Dissertation work is not only the essential part of a degree program but also a gateway for better career opportunities. Choosing a topic is not important, but what has been found in the research is the important.
- Laboratory research projects, an approach that yields a deeper understanding of how science is practiced by scientists through problem solving and the formulation and testing of a hypothesis-based research.

Course Outcomes:

- To bestow the students with all the research skills required to work independently
- To develop scientific temperament and social responsibilities in the students.
- To inculcate nature care by imparting knowledge of advance modern techniques
- As Biotechnology is an interdisciplinary course, empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology.
- Acquire knowledge in students of biotechnology enabling their applications in industry and research.

Evaluation of project dissertation work may be as per the following guidelines:

Project model (if any) and the Project record notebook= 75 marks

Project presentation and viva-voce= 25 marks

Overall project dissertation may be evaluated under the following heads:

- Motivation for the choice of topic
- Project dissertation design
- Methodology and Content depth
- Results and Discussion
- Future Scope & References
- Presentation style
- Viva-voce

PROJECT WORK/ DISSRERTATION/ PAPER PRESENTATION

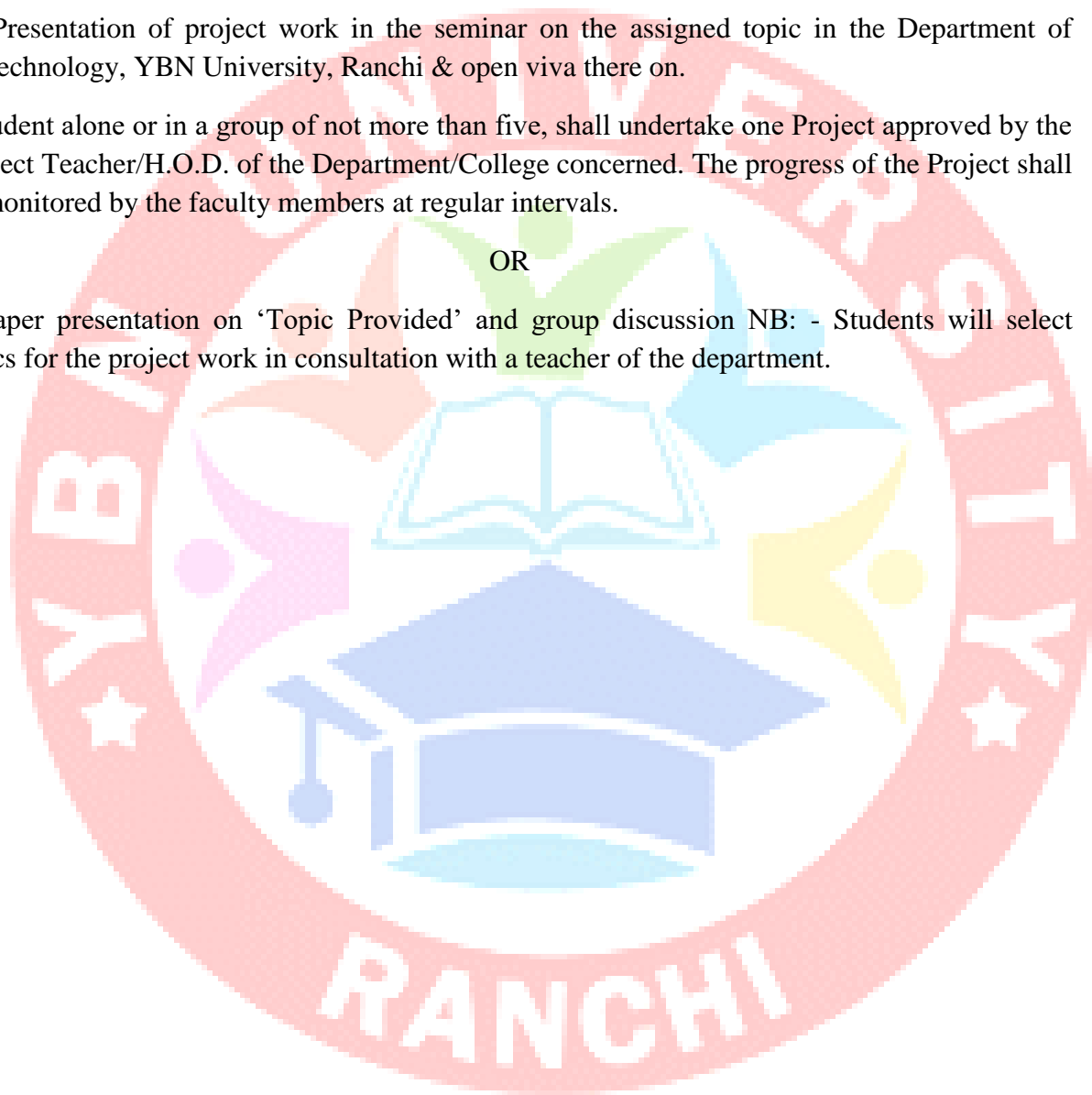
Each student has to submit two copies of the dissertation work duly forwarded by the HOD of Department concerned. The forwarded copies will be submitted in the Department of Biotechnology, YBN University, Ranchi for evaluation (15 days before the seminar).

The paper will consist of

- (a) Field work/Lab work related to the project.
- (b) Preparation of dissertation based on the work undertaken.
- (c) Presentation of project work in the seminar on the assigned topic in the Department of Biotechnology, YBN University, Ranchi & open viva there on.
 - Student alone or in a group of not more than five, shall undertake one Project approved by the Subject Teacher/H.O.D. of the Department/College concerned. The progress of the Project shall be monitored by the faculty members at regular intervals.

OR

- Paper presentation on 'Topic Provided' and group discussion NB: - Students will select topics for the project work in consultation with a teacher of the department.



Genetics

Course code: 3Y4BTMJ-3

THEORY

TOTAL HOURS: 60

CREDITS: 4

Course Objectives:

- To develop basic understanding on human genetics and heredity.
- Be able to distinguish between molecular genetics, behavioral genetics and behavioral genomics.
- Understand how genes and chromosomes function.
- Understand how genetic disorders develop and what role genetic testing and counseling play in identifying, preventing and treating these disorders.
- Know how we study the relationship between our genetic inheritance and our traits and behaviors.
- Understand how genes and the environment interact.

Course Learning Outcomes:

After completion of this subject students will be able to

- Explain how DNA encodes genetic information and the role of messenger RNA and transfer RNA.
- Explain how DNA directs protein synthesis and the roles of DNA and proteins in regulating cell function.
- Define transcription and translation.
- Define the following terms:
 - > Chromosome
 - > Gene
 - > Gene product
 - > Allele
 - > Genotype

> Phenotype

> Mitosis

> Meiosis

- Define and explain the significance of "crossing over" and "random assortment" during meiosis.
- Explain how the number of chromosomes changes during male and female gametogenesis and fertilization.
- Explain the biological basis of Down's Syndrome.
- Define the following terms:
 1. Homozygous
 2. Heterozygous
 3. Dominant
 4. Recessive
 5. Co-dominance
 6. Sex-linked inheritance
- Demonstrate how to predict the possible genotypes that could occur in an offspring, provided one knows the genotype of the two parents.
- Explain what a mutation is and give examples of how it might occur.
- Explain the contribution of mutations to evolution.
- Explain and give examples of natural selection.

UNIT I

No. of Hours: 12

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance.

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics: Mendel's experimental design, monohybrid, di hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II

No. of Hours: 12

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition –unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA.

UNIT III

No. of Hours: 12

Genetic organization of prokaryotic and viral genome. Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT IV

No. of Hours: 12

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities – Aneuploidy and Euploidy. Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X- syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT V

No. of Hours: 12

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing over, Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

GENETICS (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -Rhoeo translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

SUGGESTED READING

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

B.Sc. BIOTECHNOLOGY (NEP STRUCTURE)

Four-Year (8 Semester) Full Time Degree Programme

B.Sc. Biotechnology – Second Year Semester – IV

Major, Minor & Vocational Courses			Examination Structure			
Code	Papers	Credits	Theory (F.M.)	Practical	Internal Assessment	Total
4Y4BTMJ-4	Major paper-4 (Disciplinary/Interdisciplinary Major) General Microbiology	6	50	25	25	100
4Y4BTMJ-5	Major paper-5 (Disciplinary/Interdisciplinary Major) Immunology	6	50	25	25	100
4Y4BTMN-1	Minor paper-1 (Disciplinary/Interdisciplinary Minor) Pharmaceutical Biotechnology	6	50	25	25	100
4Y4VS-1	Vocational Studies-1 (Minor) Introduction to Stock Market-VS-1	4	50	25	25	100

SEMESTER IV
GENERAL MICROBIOLOGY

Course code: 4Y4BTMJ-4

THEORY

TOTAL HOURS: 60

CREDITS: 4

Course Objectives:

- Explain how microbes affect our daily lives
- Apply pure culture technique
- Observe and measure microbial growth
- Develop core competencies in microbiology: structure and function, information flow, energy transfer and evolution
- Manipulate bacteria genetically to address biological questions
- Enhance their understanding of the microbial world and apply their knowledge to various concepts.

Course Learning Outcomes:

After successful completion of this particular subject students are expected to be able to:

- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures
- Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively Comprehend the various methods for identification of unknown microorganisms
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy

- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

UNIT I

No. of Hours: 12

Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used to include molecular approaches, Microbial phylogeny and current classification of bacteria.

UNIT II

No. of Hours: 12

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and unique features of viruses.

UNIT III

No. of Hours: 12

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT IV

No. of Hours: 12

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria. Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT V

No. of Hours: 12

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents Water Microbiology: Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal. Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

GENERAL MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

SUGGESTED READING

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). *Introductory Mycology*. 4th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7th edition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). *Introductory Phycology*. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). *Brock Biology of Microorganisms*. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). *General Microbiology*. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley and Klein's Microbiology*. 7th edition. McGraw Hill Higher Education.

IMMUNOLOGY

Course code: 4Y4BTMJ-5

Course Objective:

- Introduce basic concepts of immunology as it relates to human and animal health.
- Encourage to understand the fundamentals of immunology
- Aim to provide students with an understanding of the immune system and its components
- Describe how the immune system is able to discriminate self vs. non-self.
- Explain how the innate and adaptive immune systems work together to generate an effective immune response against a specific pathogen.
- Explain how the immune system is able to respond to so many diverse antigens.
- Describe the various steps and checkpoints involved in lymphocyte development.
- Explain how and why certain immune cells change their phenotype following activation.
- Given certain symptoms of a clinical disease or manipulation, predict the immunological cause of the disorder.

Course Outcome:

After going through this subject student shall be able to:

- Understand the history and development of immunology.
- Explain surface membrane barriers and their protective functions.
- Describe the importance of phagocytosis and natural killer cells in innate body defense.
- Describe the roles of different types of T cells, B cells and APCs.
- Compare and contrast the origin, maturation process, and general function of B and T lymphocytes.
- Define antigen and describe how antigens affect the adaptive defenses.
- Discuss the properties of antigens.

- Understand the importance of haptens and adjuvants.
- Explain the structure, properties and functions of antibodies.
- Compare and contrast primary and secondary immune response.
- Describe the mechanisms of hypersensitivity reactions (I-IV)
- Give detailed description of various types of tests.
- Understand the vaccines and their importance.
- Production of different types of vaccines, storage, transport.
- Various techniques used to know about Ag-Ab reaction.
- Production of Monoclonal Ab

THEORY

TOTAL HOURS: 60

CREDITS: 4

UNIT I

No. of Hours: 12

Immune Response - An overview, components of mammalian immune system, molecular structure of Immuno-globulins or Antibodies, Humoral & Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells),

UNIT II

No. of Hours: 12

T-cell receptors, genome rearrangements during B-lymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.

UNIT III

No. of Hours: 12

Antigen and their properties and functions, Structures and types of antibodies, Antigen antibodies interactions Regulation of immunoglobulin gene expression – clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, Monoclonal antibodies, production of Mab, Hybridoma technology, antibody diversity.

UNIT IV

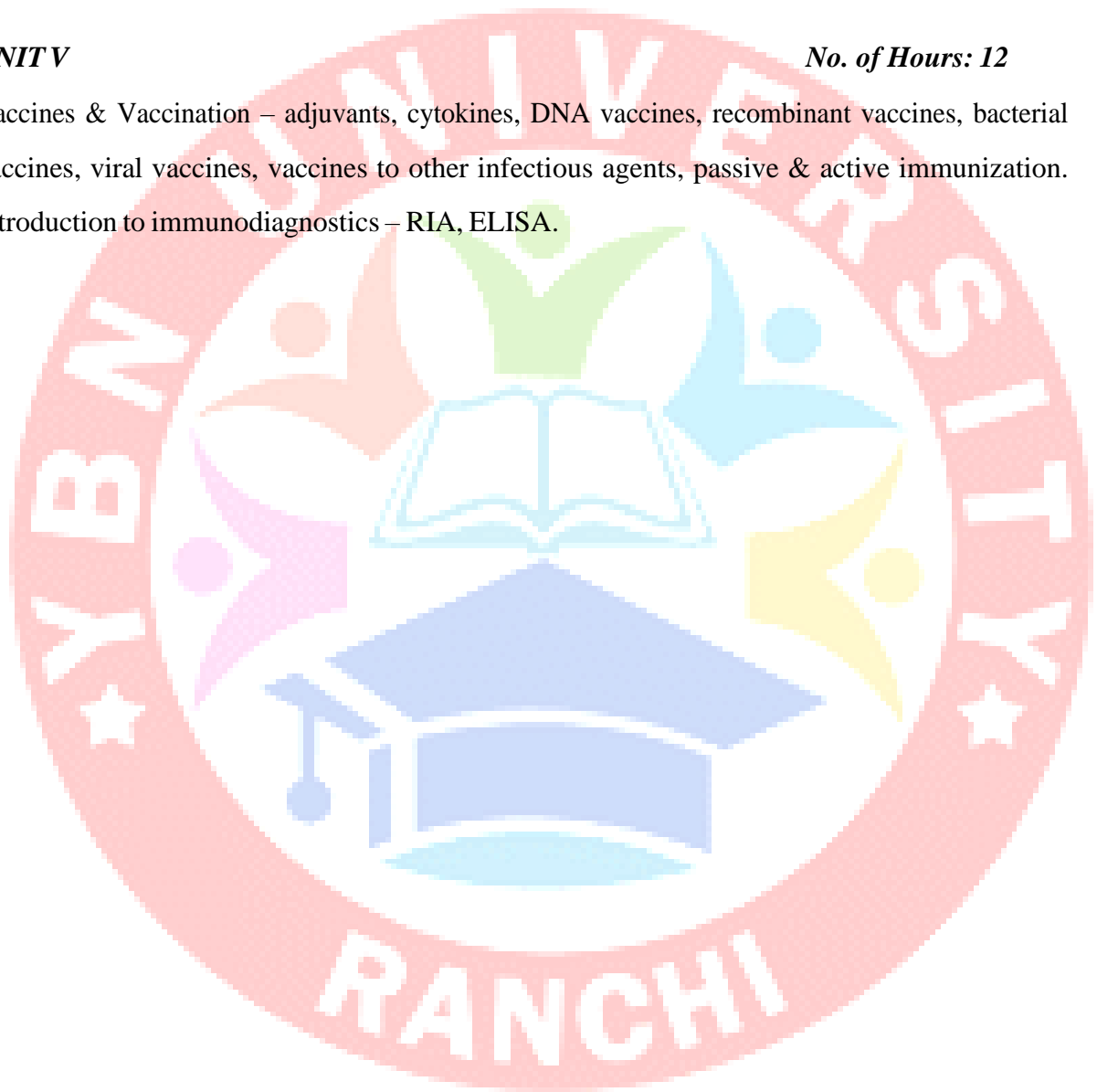
No. of Hours: 12

Major Histocompatibility complexes – class I & class II MHC antigens, antigen processing. Immunity to infection – immunity to different organisms, pathogen defense strategies, avoidance of recognition. Autoimmune diseases, Immunodeficiency-AIDS, Hypersensitivity and its types.

UNIT V

No. of Hours: 12

Vaccines & Vaccination – adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization. Introduction to immunodiagnostics – RIA, ELISA.



IMMUNOLOGY (PRACTICAL)

TOTAL HOURS: 60

CREDITS: 2

1. Differential leucocytes count
2. Total leucocytes count
3. Total RBC count
4. Haemagglutination assay
5. Haemagglutination inhibition assay
6. Separation of serum from blood
7. Double immunodiffusion test using specific antibody and antigen.
8. ELISA.

SUGGESTED READING

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley- Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.
7. 2nd edition Churchill Livingstone Publishers, Edinberg.
8. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

PHARMACEUTICAL BIOTECHNOLOGY

Course code: 4Y4BTMN4

TOTAL HOURS: 60

CREDITS: 4

Course objectives:

- Provide brief introduction to biotechnology with reference to pharmaceutical sciences
- Acquire knowledge in basic principle of genetic engineering and enzyme technology
- Aims to fight and prevent diseases and improve health
- Create biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Apply the principles of biosensors and protein engineering in Pharmaceutical Industry
- Explain the concepts of rDNA technology and its applications
- Describe the concept of immunity and production of vaccine
- Define hybridoma technology and understand hypersensitivity reaction
- Knowledge on genetic multiplication and biotransformation
- Discuss the principles of fermentation its design and production of pharmaceutical products
- Describe various blood products, plasma collection and processing of it.

Course outcome:

Upon completion of the subject student shall be able to;

- Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
- Genetic engineering applications in relation to production of pharmaceuticals
- Importance of Monoclonal antibodies in Industries
- Appreciate the use of microorganisms in fermentation technology
- Able to understand the various drug delivery system and its mechanisms
- Provide examples of current applications of biotechnology and advances in different areas like medical, microbial, environmental, bioremediation, agricultural, plant animal and forensic
- Demonstrate and provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products

Unit I: Brief introduction to Biotechnology

No. of Hours:10

1. Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
2. Enzyme Biotechnology- Methods of enzyme immobilization and applications.
3. Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
4. Brief introduction to Protein Engineering.
5. Use of microbes in industry. Production of Enzymes- General consideration – Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
6. Basic principles of genetic engineering.

Unit II: DNA Technology

No. of Hours:7

1. Study of cloning vectors, restriction endonucleases and DNA ligase.
2. Recombinant DNA technology. Application of genetic engineering in medicine.
3. Application of r DNA technology and genetic engineering in the production of:
i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.
4. Brief introduction to PCR

Unit III: Immunity

No. of Hours:10

Types of immunity- humoral immunity, cellular immunity

1. Structure of Immunoglobulins
2. Structure and Function of MHC
3. Hypersensitivity reactions, Immune stimulation and Immune suppressions.
4. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
5. Storage conditions and stability of official vaccines
6. Hybridoma technology- Production, Purification and Applications
7. Blood products and Plasma Substitutes.

Unit IV: Immunological Techniques

No. of Hours:8

1. Immuno blotting techniques- ELISA, Western blotting, Southern blotting.
2. Genetic organization of Eukaryotes and Prokaryotes
3. Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
4. Introduction to Microbial biotransformation and applications.
5. Mutation: Types of mutation/mutants.

Unit V: Fermentation

No. of Hours:7

1. Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
2. Large scale production fermenter design and its various controls.
3. Study of the production of – penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
4. Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

PHARMACEUTICAL BIOTECHNOLOGY (PRACTICAL)

CREDITS:2

1. Isolation and purification of nucleic acid and protein, Electrophoresis and visualisation of nucleic acid and protein, Blotting techniques, Sequencing and amplification techniques, PCR and related techniques
2. Gene purification and sequencing, Protein sequencing and purification, The goal and applications of genomics and proteomics, Techniques in use for gene and protein analysis, e.g. crystallography, magnetic resonance
3. Antibody production and labeling, Immunochemical techniques for in situ analyses (ICC and IHC), Immunochemical techniques for measurement (ELISA, etc), Immunochemical techniques for separation (Immunoprecipitation, etc)
4. Organization of biological data, databases (raw and processed), quering in databases, primer designing, gene finding, motif finding, sequence alignment, protein sequence analysis

Suggested Reading

- B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
- RA Goldshy et. al.: Kuby Immunology. J.W. Goding: Monoclonal Antibodies.
- J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
- Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
- S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
- Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi



INTRODUCTION TO STOCK MARKET – VS-1

Course Code: 4Y4VS-1

(Credits: Theory-01 + Practical 02)

Course Content:

Unit I: Financial System and Services:

Nature and role of financial structure - Financial system and financial markets - Financial system and economic development -Indian financial system: an overview; Investment alternatives and evaluation; Reforms in financial system, Investment banking; Credit Rating; Factoring and Forfaiting; Housing Finance; Leasing and hire purchase; Financial inclusion and Microfinance

Unit II: Financial Markets:

Money market- meaning, constituents & function; Money market instruments – call money, treasury bills, and certificate of deposits, Commercial bills, and trade bills, Acceptance Houses, Discount Houses; Capital markets – primary and secondary market; Government securities markets; Role of SEBI - an overview and recent developments. Role of RBI, SEBI, DFHI, SHCI in Financial Markets.

Unit III: Financial Institutions:

Reserve bank of India – organization, management, and function; Commercial banks - meaning, functions and investment policies; Development banks – concept, objectives, and function; Insurance companies – objectives, role, and investment practices, -IRDS; Unit Trust of India – objective, function, and schemes; role and functions of non-banking financial institutions; Merchant banking- functions and role.

Unit IV: Financial Instruments

Sources of finance – Financial Instruments – Types, Features and advantages – Equity and special types of equity, ADRs & GDRs; Preferred stock - Equity derivatives – Credit derivatives-Asset – backed securities - Convertibles and warrants - Types of Bonds and debentures- Non- Marketable Financial Assets - Options instruments – securitization.

Unit V: Mutual Funds:

Concept and performance of Mutual funds; Regulation of Mutual funds (with special reference to SEBI guidelines); Designing and marketing of mutual fund schemes; Latest mutual funds schemes in India – an overview; Mutual Fund Evaluation and Tax aspects of Mutual Fund Investments.

Unit VI: Capital Markets in India

An overview of Indian Securities Market, Meaning, Functions, Intermediaries, Role of Primary Market – Methods of floatation of capital – Problems of New Issues Market

– IPO's- Investor protection in primary market – Recent trends in primary market – SEBI measures for primary market.

Unit VII: Stock exchanges and its Functions:

Meaning, Nature, Functions of Secondary Market – Organisation and Regulatory framework for stock exchanges in India – SEBI: functions and measures for secondary market – Overview of major stock exchanges in India - Listing of Securities: Meaning – Merits and Demerits – Listing requirements, procedure, fee – Listing of rights issue, bonus issue, further issue – Listing conditions of BSE and NSE – Delisting

Unit VIII: Trading, settlement and Surveillance System in Stock Exchanges:

Different trading systems – BSE - BOLT System – Different types of settlements - Pay-in and Pay-out – Bad Delivery – Short delivery – Auction – NSE – NEAT system options – Market types, Order types and books – De-mat settlement – Physical settlement – Institutional segment – Funds settlement – Valuation debit – Valuation price – Bad and short delivery Risk management system in BSE & NSE – Margins – Exposure limits – Surveillance system in BSE & NSE – Circuit breakers

Unit IX: Stock Market Indices:

Meaning, Purpose, and Construction in developing index – Methods (Weighted Aggregate Value method, Weighted Average of Price Relatives method, Free-Float method) – Stockmarket indices in India – BSE Sensex - Scrip selection criteria – Other BSE indices (briefly) – NSE indices – S&P CNX Nifty – Scrip selection criteria – Construction – Stock market indices in foreign countries (Overview).

Unit X: Commodity and Currency Markets:

Commodity exchanges: evolution and history- role in globalizing economy – governing regulations – price –risk management – commodity exposure – hedge accounting – currency futures – managing exchange rate – carbon markets – weather derivatives – ETFs–Purpose, Importance, types, construction

INTRODUCTION TO STOCK MARKET PRACTICAL- VC-1 LAB:

PRACTICALS:

60

Lectures

1. Visit to a local market to study various marketing functions performed by different agencies (market functionaries).
2. Identification of marketing channels for selected mutual fund.
3. Identification of marketing channels for selected Equity
4. Identification of marketing channels for selected commodity.
5. Computation of marketable and marketed surplus of important commodities.
6. Construction of index numbers.
7. Collection of data regarding marketing cost and marketing margins of different commodities and presentation of report in the class.
8. Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning.
9. Application of principles of comparative advantage of international trade
10. Plotting and study of demand and supply curves and calculation of elasticities.
11. Study of relationship between market arrivals and prices of some selected commodities.
12. Study of price behaviour over time for some selected commodities