Shivaji University, Kolhapur

Established: 1962
Accredited by NAAC A++ (2021) with CGPA 3.52

Structure and Syllabus in Accordance with
National Education Policy - 2020

with Multiple Entry and Multiple Exit

Syllabus For
B.Sc.Part–I

BIOTECHNOLOGY

(Optional/Vocational)
(Faculty of Science and Technology)
SEMESTER I AND II
(To be implemented from Academic Year, 2024-25 onwards as per NEP2020)

SHIVAJIUNIVERSITY,KOLHAPUR

NEP-2020(2.0):CreditFrameworkforUG(B.Sc.)ProgrammeunderFacultyofScienceandTechnology

SEM (Level)	COURSES			OE	VSC/SEC	AEC/VEC/IKS	OJT/FP/ CEP/CC/ RP	Total Credits
	Course-1	**Course-2**	**Course-3**					
SEM I (4.5)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	DSC-I(2) DSC-II(2) DSCP-I(2)	OE I- (2) (T/P)	-	IKS-I (2)	--	**22**
SEM II (4.5)	DSC-III(2) DSC-IV(2) DSCP-II(2)	DSC-III(2) DSC -IV(2) DSCP-II(2)	DSC III(2) DSC IV(2) DSCP-II(2)	OE-II -(2) (T/P)	-	VEC-I (2) (Democracy, Election and Constitution)	--	**22**
Credits	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**8(T)+4(P)=12**	**2+2=4 (T/P)**	**--**	**2+2=4**	**--**	**44**

Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

Shivaji University, Kolhapur

Revised Syllabus For Bachelor of Science Part – I : Biotechnology

1. TITLE: Biotechnology (OPTIONAL / VOCATIONAL)

2. YEAR OF IMPLEMENTATION:- Revised Syllabus will be implemented from June, 2024 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Biotechnology to undergraduate students at first year of three years of B.Sc. degree course.

Students learn Biotechnology as a separate subject from B.Sc. I. The goal of the syllabus is to make the study of Biotechnology popular, interesting and encouraging to the students for higher studies including research.

The new and updated syllabus is based on a basic and applied approach with vigor and depth. At the same time precaution is taken to make the syllabus comparable to the syllabi of other universities and the needs of industries and research.

The syllabus is prepared after discussion at length with number of faculty members of the subject and experts from industries and research fields.

The units of the syllabus are well defined, taking into consideration the level and capacity of students.

4. GENERAL OBJECTIVES OF THE COURSE/ PAPER:

1) To make the students knowledgeable with respect to the subject and its practicable applicability.

2) To promote understanding of basic and advanced concepts in Biotechnology.

3) To expose the students to various emerging areas of Biotechnology.

4) To prepare students for further studies, helping in their bright career in the subject.

5) To expose the students to different processes used in industries and in research field.

6) To prepare the students to accept the challenges in life sciences.

7) To develop skills required in various industries, research labs and in the field of human health.

5. Program Specific Outcomes:

PSO1: Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom.

PSO 2: To understand the various aspect of enzyme technology and spectroscopy.

PSO 3: To understand the basics of genetics and molecular biology.

PSO 4: To understand the antigen antibody reactions and types of immunity.

PSO 5: To understand the technics and applications in r-DNA technology

PSO 6: Perform job in various fields like food, pharmaceutical, agriculture, health care, public services and business etc.

PSO 7 : Be an entrepreneur with precision, analytical mind, innovative thinking, and clarity of thought, expression and systematic approach.

6. DURATION

- The course shall be a full time course.

7. PATTERN:-

Pattern of Examination will be Semester

EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS OF PAPERS- (FOR REVISED SYLLABUS)

Sr.No.	Title of Old paper	Title of New paper
1	Paper I DSC-17A Basics of Biotechnology I	Paper I DSC-I Basics of Biotechnology I
2	Paper II DSC-18A Basics of Biotechnology II	Paper II DSC-II Basics of Biotechnology II
3	Paper III DSC-17-B: - Basics of Cell biology and Microbiology	Paper III DSC-III: - Basics of Cell biology and Microbiology
4	PAPER IV DSC -18 B – Basics of Microbiology	PAPER IV DSC- IV – Basics of Microbiology

SEMESTER-I

F.Y. B. Sc. (Biotechnology)

DSC - I Paper – 1 Basics of Biotechnology – I

[CREDITS – 02; LECTURES – 30 hours; LEC/WEEK – 02]

After completion of this course, students will be able to

1. Understand basics of Biotechnology. .
2. Learn about different biomolecules like Carbohydrate and Protein.
3. Know basics of enzyme.

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Biotechnology - Definition, history of biotechnology, scope & importance of biotechnology, branches of biotechnology, biotechnology in India, Commercial potentials of Biotechnology, Achievements of Biotechnology, Misuse of Biotechnology, Prevention of misuse of Biotechnology, Future of Biotechnology. **Carbohydrate -** General classification of carbohydrates, ring formation in monosaccharide, mutarotation, formation of glycosidic bond, study with respect to structure, chemical properties, hydrolysis of disaccharides (e.g., sucrose, maltose, lactose) oligosaccharides, polysaccharides (e.g., starch, glycogen, cellulose, peptidoglycan) biological functions of carbohydrates.	
2	**Credit - II**	**15**
	Protein -Introduction, General structure of amino acids, Structural classification of amino acids based on R side chain, Structure of peptide bond, biological functions, structural levels of protein- Primary, Secondary, Tertiary (Myoglobin), Quaternary (Hemoglobin) **Enzyme (basic concepts) -** Definition, concept of Holoenzyme, Apoenzyme, Coenzyme, Cofactor, Prosthetic group, Active site, Types- extracellular, intracellular, constitutive, inducible.	

References –

- Biochemistry- Lubert Stryer
- Textbook of Biotechnology – R. C.Dubey.
- Biochemistry by –Lehninger
- Biochemistry – U. Satyanarayana
- Biotechnology expanding horizons- B. D. Singh, Kalyani Publisher
- Elementsof biotechnology- P. K. Gupta

SEMESTER-I

F.Y. B. Sc. (Biotechnology)

DSC - II Paper – 2 Basics of Biotechnology – II

[CREDITS – 02; LECTURES – 30 hours; LEC/WEEK – 02]

After completion of this course, students will be able to

1. Learn basics of biomolecules like nucleic acid and lipids
2. Understand the basic working of Microscopy and Colorimeter
3. Handle instruments during project.

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Nucleic acids - Definition, Structure of nitrogenous bases, pentose sugar and phosphoric acid. Nucleosides, nucleotides, polynucleotides, Forms of DNA- A, B, Z. Watson and Crick's structural model of DNA, RNA: Chemical composition, structure and functions of mRNA, rRNA, tRNA. Forces stabilizing nucleic acid structure. **Lipid –** Definition, Classification of lipids - Simple lipid- (triacylglycerols & waxes), Compound lipid- (phospholipids, sphingolipids, cerebrosides), Derived – e.g., cholesterol. Chemical and physical properties of lipid. Functions of lipids.	
2	**Credit - II**	**15**
	General Principles of Microscopy – Image formation, Magnification, Numerical aperture (uses of oil immersion objective). Concept of Resolving power and Working distance. Ray diagram, principle and applications of– i) Compound Microscope ii) Electron Microscope • Scanning Electron Microscope • Transmission Electron Microscope. **Colorimeter** - Lambert-Beer's law principle, construction & working of Colorimeter	

References –

- Principles of Biochemistry- Zubay and Geoffrey
- Biochemistry- Lubert Stryer
- Outline of biochemistry- Conn & Stumph
- Textbook of Biotechnology – R. C. Dubey.
- Biochemistry by – Lehninger

DSC Practical -I PRACTICALS BASED ON DSC I & II

[CREDITS – 02; PRACTICALS – 60 hours; PRACTICALS/WEEK – 04]

Lab. Exercises in Cell Biology and Microbiology

Learning Objectives:

1. To understand basic techniques in Biotechnology laboratory.
2. To study working principal, handling and use of compound microscope.
3. To study the preparation, sterilization and use of various culture media.

Sr No	Name of The Experiment
1	Use, care and study of Compound Microscope
2	Demonstration of some lab equipments:- Autoclave, Hot air Oven, Incubator, LAF, Centrifuge, Colorimeter, Water bath, Colony Counter, Water distillation unit.
3	Preparation of Buffers
4	Preparation of Molar and Normal solutions - Molar solution of Sucrose - Normal solutions of alkali- NaOH and Acid-HCl
5	Preparation of Culture media -Peptone water, Nutrient broth and Nutrient Agar -MacConkey's Agar Sabaroud's Agar Starch Agar Milk Agar
6.	Microscopic Examination of Bacteria **1.** Monochrome staining **2.** Negative Staining **3.** Gram's Staining **4.** Hanging drop technique-Motility.
7.	Enumeration of Bacteria from soil by total viable count- Pour plate technique.
8.	Mounting and identification of mould- *Penicillium, Aspergillus*
9.	Isolation of Starch from Potato
10.	Isolation of Casein from Milk

SEMESTER - II

PAPER III DSC-III: -Basics of Cell Biology and Microbiology

[CREDITS – 02; LECTURES – 30 hours; LEC/WEEK – 02]

After completion of this course, students will be able to

- Basic concepts of cell Biology and Microbiology.
- Able to understand cell structure
- Structure and function of eukaryotic cell organelles.

Paper-III DSC-III :- Basics of Cell biology and Microbiology		
	Credit-I	
	History of Cell biology :- Cell biology before 19th century, cell biology in19th century- formulation cell theory, protoplasm theory, germplasm theory, cell biology in 20th century- organism theory, Branches of Cell Biology, Scope of cell biology. **Eukaryotic cell** Structure and function of EukaryoticCell organelles- cell membrane, nucleus, mitochondria, chloroplast, golgibodies, Endoplasmic reticulum, Ribosomes, cytoskeleton structure (actin, microtubules), lysosomes, peroxisomes. Cell cycleand Cell division - phases of cell cycle, Mitosis& meiosis.	15
	Credit- II	15
	History of Microbiology contribution of:-Anton van Leeuwenhoek, Alexander Fleming, Louis Pasteur, Robert Koch, Joseph Lister. Introduction to types of Microorganisms – Cellular - Bacteria, Algae, Fungi, Protozoa, Acellular -Viruses, **Pandemic disease - Influenza, Covid-19.** **Morphology and cytology of Bacteria** A. Morphology of Bacteria – i) Size, ii) Shape, iii)Arrangements B. Cytology of Bacteria – Structure of Typical Bacterial Cell. a) **Structure and functions of :** i) Cell wall ii) Cell membrane iii) Capsule and slime layer iv) Flagella v) Pili vi) Nuclear material vii) Mesosome viii) Ribosome	

Reference books:-

1. Cell and molecular biology-Arumugham
2. Cell and molecular biology- DeRobertis
3. Cytology genetics and evolution- Agarwal and Varma
4. Cell biology- C. B. Pawar

PAPER IV DSC-IV: -Basics of Microbiology

[CREDITS – 02; LECTURES – 30 hours; LEC/WEEK – 02]

After completion of this course, students will be able to

- Learn principles of physical and chemical methods used in control of microorganisms.
- Understand laboratory and techniques to the isolation, staining, identification and control of microorganisms.
- Learn concepts of sterilization.

PAPER IVDSC-IV– Basics of Microbiology		
	Credit-I	
	Culture media- Definition of culture media, Common components of media and their functions- Peptone, Yeast extract, NaCl, Agar and Sugar, Types: non living media- natural, synthetic, semi-synthetic & differential, enriched, enrichment & selective, living media. Methods for isolation of pure cultures- Streak plate pour plate, spread plate. **Microbial nutrition** A. Microbial Nutrition 1) Nutritional requirements of microorganisms: Water; Micronutrients, Macronutrients- Carbon and Energy source; Oxygen and Hydrogen; Nitrogen, Sulphur and Phosphorous 2) Nutritional types of microorganism based on carbon and energy sources. Autotrophs- Photoautotrophs andChemoautotrophs, Heterotrophs- Photoheterotrophs and Chemoheterotrophs.	15
	Credit- II	
	Concept of Sterilization:- Methods of Sterilization a) **Physical agents:** i) temperature-dry heat, moist heat ii) Radiation- U.V, Gamma radiation iii) Bacteria proof filter-membrane filter. b) **Chemical agents:-**Phenol & Phenolic compounds, Alcohol, Heavy metals (e.g. mercury). c) **Gaseous agents-** Ethylene oxide, formaldehyde. **Stains and staining procedures-** A. Definition of dye and stain B. Classification of stains – Acidic, Basic and Neutral C. Principle, Procedure, Mechanism and application of staining procedures i) Simple staining ii) Negative staining iii) Differential staining: Gram staining and acid fast staining.	15

Reference books:-

1. Fundamentals of Microbiology- Frobisher
2. Microbiology-Pelczar.
3. General Microbiology-Stanier.
4. Text book of Microbiology- Ananthnarayan & Panikar.
5. Cell-Cooper

DSC II Lab. Exercises in Biochemistry

Learning Objectives:

1. The students will get detailed and comprehensive knowledge on the various practical aspects of microscopy, microbial taxonomy, and basic microbial culture techniques.
2. The students will be able to analyze biochemically different biological samples.

Sr No	Name of The Experiment
1	Isolation, colony characters ,Gram's staining and motility of Bacteria isolated from- - Air-(solid impaction technique) - Water- (dilution and spreading plate technique.)
2	Study of Lambert-Beer's Law by Copper ammonia complex method.
3	Estimation of Protein- Casein by Biuret Method.(Graphical)
4	Determination of Acid Value of Given oil sample.
5	Estimation of Reducing Sugar By Benedict's Method.
6	Estimation of Glucose by DNSA Method(Graphical)
7	Estimation of DNA by Diphenyl Amine method. (by calculation)
8	Estimation of RNA by Orcinol Method. (by calculation)
9	Detection of enzyme activity- Amylase and Caesinase.
10	Study of Mitosis.
11	Isolation of Chloroplast.

Books recommended for Practicals

1) Stains and Staining procedures by Desai and Desai.
2) Introduction to Practical Biochemistry by D. Plummer, J Wiley and Sons.
3) Bacteriological techniques by F. .Baker.
4) Introduction to Microbial techniques by Gunasekaran.
5) Biochemical methods by Sadashivan and D.Manickam.
6) Laboratory methods in Biochemistry by J. Jayaraman.
7) Experimental Microbiology – Patel &Patel

List of minimum equipments-

1) Hot air oven -1
2) Incubator -1
3) Autoclave -1
4) Refrigerator -1
5) Medical microscopes - 10 nos. for one batch
6) Chemical balance -2
7) pH meter -1
8) Centrifuge -1
9) Colorimeter -1
10) Distilled Water Plant -1
11) Laminar air flow cabinet -1
12) Colony counter -1
13) Water bath -1
14) Arrangements for gas supply and fitting of two burners portable.
15) One working table of 6' x 2½' for two students.
16) One separate sterilization room attach to the laboratory (10' x15')
17) At least one wash basin for a group of five students
18) One separate instrument room attached to lab (10' x15')
19) One laboratory for one batch including working tables (6' x 2½') per two students for one batch
20) Store room (10' x15')

Practical Examination

(A) The practical examination will be conducted on two consecutive days for three hours per day per batch of the practical examination.

(B) Each candidate must produce a certificate from the Head of the Department in her/his college, stating that he/she has completed in a satisfactory manner the practical course on lines laid down from time to time by Academic Council on the recommendations of Board of Studies and that the journal has been properly maintained.

(C) Every candidate must have recorded his/her observations in the laboratory journal and have written a report on each exercise performed. Every journal is to be checked and signed periodically by a member of teaching staff and certified by the Head of the Department at the end of the year. Candidates must produce their journals at the time of practical examinations.

Note: - At least 80% Practicals should be covered in practical examination.

- **THER FEATURES :**

(A) LIBRARY:

References and Text Books, Journals and Periodicals, Reference Books– List Attached

(B) LABORATORY SAFETY EQUIPMENTS :

1) Fire extinguisher
2) First aidkit
3) Fumigation chamber
4) Stabilized power supply
5) Insulated wiring for electric supply.
6) Good valves & regulators for gassupply.
7) Operational manuals for instruments.
8) Emergency exits

OE - I Paper – 1 Basics of Molecular Biology – I

After completion of this course, students will be able to

1. Understand basic concepts of Molecular biology
2. learn fundamentals of cytogenetics
3. Basic concepts of genome and genetic material

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Nucleic acids - introduction ❖ Structure of DNA ❖ Structure of RNA and types ❖ Investigational studies for genetic material ❖ Griffith's experiment ❖ Avery- Macleod- McCarty experiment ❖ Hershey- Chase experiment ❖ Packaging of DNA into Chromosome	
2	**Credit - II**	**15**
	Genome – introduction ❖ Gene (Introns and Exons) ❖ Eukaryotic Chromatin ❖ Euchromatin and heterochromatin ❖ Centromere ❖ Telomere ❖ Cytogenetics ❖ Human Karyotype ❖ Variation in chromosome number ❖ Chromosomal aberrations ❖ Central Dogma – introduction	

References –

- Molecular biology of the cell – Bruce Alberts
- Molecular biology of the genes – James D. Watson
- Molecular biology – Robert F. Weaver
- Life Sciences – Pranav Kumar

OE - II Paper – 2 Basics of Molecular Biology – II

After completion of this course, students will be able to

1. Aware of fundamentals of rDNA technology.
2. Introduce different techniques used for introduction of DNA into the host cells
3. Basics of techniques used in molecular biology.

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Manipulation of DNA (rDNA technology) ❖ Enzymes used in molecular biology ❖ Vectors ❖ Introduction of DNA into the host cells ❖ In bacterial cells ❖ In plant cells ❖ In animal cells ❖ Selectable and screen able markers ❖ DNA library ❖ Genomic library ❖ cDNA library	
2	**Credit - II**	**15**
	Isolation of nucleic acids ❖ Isolation of DNA ❖ Isolation of RNA ❖ Molecular biology techniques ❖ Electrophoresis ❖ Polymerase chain reaction (Conventional PCR and RT-PCR) ❖ DNA Fingerprinting ❖ Blotting techniques (Southern blotting and Northern blotting)	

References –

- Molecular biology – Robert F. Weaver
- Molecular biology of the cell – Bruce Alberts
- Life Sciences – Pranav Kumar
- Molecular biology of the genes – James D. W

OE-III (2)-Plant tissue culture

After completion of this course, students will be able to

- Understand basic concepts with the brief history and applications of plant cell cultures
- Learn components of nutrient medium and their role.
- Learn methods of sterilization by various agents.

OE-III (2) – Plant tissue culture -1		
	Credit-I	
	Plant tissue culture- Definition , Introduction, History, scope and importance of plant tissue culture .Laboratory organization – washing facility, General laboratory and media preparation area ,Transfer area , culturing facilities, light unit, transplantation area **Nutrition Medium-** Media Composition-Inorganic nutrients. Carban and energy source vitamins, growth regulators, organic supplements, gelling agents, PH	15
	Credit- II	
	Sterilization Techniques:- Methods of sterilization Steam Sterilization, Dry Sterilization, filter Sterilization, U.V Sterilization Alcohol Sterilization Flame Sterilization, **Aseptic Manipulation** Sterilization the culture vessels and instruments, Sterilization culture media, Sterilization culture rooms and transfer area, Aseptic Culture Technique,	15

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Reference books:-

- Introduction to plat tissue culture- M.K Razdan
- Plant tissue culture- Kalyankumardey
- Plant tissue culture- U.Kumar

OE-IV (2) – Plant tissue culture -2

After completion of this course, students will be able to

- Understand concepts of plant cell cultures
- Learn basic components of Suspension Cultures.
- Know protocols of cultures

OE-IV (2) – Plant tissue culture -2		
	Credit-I	
	Credit –I Cell Culture- Isolation of single cells- 1)From plant organs – i)Mechanical method, ii) Enzymatic method 2)From cultured tissues Types of Suspension Cultures –i) Batch cultures ii)Continuous cultures Culture medium for cell suspensions – i)Conditioning of medium ii)Agitation of the medium Culture of isolated single cells – i)plating technique ii)plating efficiency	15
	Credit- II Types of culture – Seed culture – In-vivo condition, In- vitro condition, Embryo culture- mature embryo culture, immature embryo culture, applications of embryo culture Root culture, callus culture, organ culture- organized and nonorganized Protocols - Protocol for seed germination- Plant material, plant establishment, Protocol for embryo culture, Protocol for callus induction – plant material, procedure	15

Reference books:-

- Introduction to plat tissue culture- M.K Razdan
- Plant tissue culture- Kalyankumardey
- Plant tissue culture- U.Kumar

B.SC.I SEMESTER I BIOTEHNOLOGY
SEC I BASIC INSTRUMENTATION IN BIOTECHNOLOGY

After completion of this course, students will be able to

1: Learn basic techniques used in common laboratory instruments.
2: Understand thefundamentals of centrifugation.
3: Learn theinstrumentation&working of UVvisible spectroscopy.

B.SC.I SEMESTER I BIOTEHNOLOGY
SEC I BASIC INSTRUMENTATION IN BIOTECHNOLOGY

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Basic instrumentation ❖ Introduction, principle & application of - ❖ pH meter ❖ Autoclave ❖ Laminar airflow ❖ Hot air Oven ❖ Colorimeter	
2	**Credit – II**	**15**
	Centrifugation ❖ Types of centrifuges: - ❖ Desktop ❖ High speed ❖ Ultracentrifuge ❖ Centrifugation: Differential anddensitygradientcentrifugation ❖ Care and use	

B.SC.I SEMESTER II BIOTEHNOLOGY

SEC II BASIC INSTRUMENTATION IN BIOTECHNOLOGY

After completion of this course, students will be able to

1: Learn basic techniques used in common laboratory instruments.

2: Understand the concept of electrophoresis.

3: Learn the instrumentation & working of Spectroscopy

Topic No.	Topic	No. of Lectures
1	**Credit - I**	**15**
	Electrophoresis - ❖ Introduction & Principle ❖ Agarose gel electrophoresis ❖ DNA sequencing gel ❖ Pulsed filed gel electrophoresis ❖ SDS-PAGE electrophoresis ❖ Applications of electrophoresis	
2	**Credit - II**	**15**
	Spectroscopy- ❖ Introductiontospectroscopy, ❖ Principle, Instrumentation and applications of colorimeter. ❖ Principle, Instrumentation, Applications of UV and Visible Spectrophotometer. ❖ Fluorescence spectroscopy, ❖ Atomic spectroscopy	

Referencebooks:

- PracticalBiochemistryprinciplesandtechniques–WillsonandWalker
- ProteinpurificationbyRobertScope
- Biophysicalchemistry – NathUpadhyay Nath
- Bioinstrumentation –Veerakumari

SEC Practical I: Practical on Instrumentation I

Topic	No. of Lectures
1. Calibration of pH meter 2.Demonstration of Centrifuge 3.Demonstration of Laminar air flow 4.Calibration of Autoclave 5.Demonstration of Hot air oven 6.Constuction and operation of Incubator	**30**

SEC Practical II: Practical on Instrumentation II

Name of the experiment	No. of Lectures
1.Demonstration of Agarose gel electrophoresis 2.Demonstration of UV transilluminator 3.Demonstration of spectrometer 4. Demonstration of Colorimeter. 5.Use care and handling of micro-pipetting 6. Demonstration of Neubauer chamber.	**30**

Nature of Question Paper for B.Sc. Part – I, II & III (40 + 10 Pattern) according to Revised Structure as Per NEP – 2020 to be implemented from academic year 2024

Maximum Marks: 40

Duration: 2 hrs

Q. 1 Select the most correct alternate from the following [8]

i) to viii) MCQ one mark each with four options

A)

B)

C)

D)

Q.2 Attempt any TWO of the following [16]

A)

B)

C)

Q. 3 Attempt any FOUR of the following [16]

A)

B)

C)

D)

E)

F)

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