POST GRADUATE PROGRAMME IN BIOTECHNOLOGY

1. At each of the Previous and Final Year Examination in a subject, a candidate must obtain for a pass (i) at least 36 % marks of the aggregate marks in all the papers prescribed at the examination, and (ii) atleast 36% marks in practical, wherever prescribed, at the examination; provided that if a candidate fails to secure 25% marks in each individual paper of theory at any of the examination and also in the dissertation; wherever prescribed, he/she shall be deemed to have failed at the examination, notwithstanding his/her having obtained the minimum percentage of marks required in the aggregate for the examination. Division will be awarded at the end of the Final Examination of the combined marks obtained at the Previous and the Final Examinations taken together as noted below. No Division will be awarded at the Previous Examination.

First Division	: 60 Percent	of the total aggregate marks of Previous and Final year taken together
Second Division	: 48 Percent	
Third Division	: 36 Percent	

Note : The candidate is required to pass separately in theory and practicals.

2. Dissertation may be offered by regular students only in lieu of one paper of Final Year Examination as prescribed in the syllabus of the subject concerned. Only such candidates will be permitted to offer dissertation who have secured atleast 50% marks in the aggregate at the previous examination.

Note: Dissertation shall be type-written and shall be submitted in triplicate, so as to reach the Controller of Examinations atleast two weeks before the commencement of Examination.

3. There shall be atleast eight theory papers in Post-Graduate Examination, 4 in Previous and 4 in Final year examinations of 100 marks each unless and otherwise prescribed. The non-credit papers wherever prescribed will remain as such. The marks of these non-credit papers will not be counted for division but passing in the same is compulsory.

4. Each theory paper will be of three hours duration.

5. Wherever practicals are prescribed the scheme will be included in the syllabus.

6. A candidate who has completed a regular course of study for one academic year and passed M.A. / M.Sc./ M.Com. Previous Examination of the university shall be admitted to the Final Year

Examination for the degree of Master of Arts / Master of Science / Master of Commerce provided that he / she has passed in atleast 50% of the papers at the previous examination by obtaining atleast 36% marks in each such paper.

(a) For reckoning 50% of the papers at the previous examination, practical will be included and one practical will be counted as one paper.

(b) Where the number of papers prescribed at the previous examination is an odd number it shall be increased by one for the purpose of reckoning 50% of the paper.

(c) Where a candidate fails for want of securing minimum aggregate marks but secured 36% marks in atleast 50% of the papers, he/she will be exempted from re-appearing in those papers in which he/she has secured 36% marks.

(d) Where the candidate secures requisite minimum percentage in the aggregate of all the papers but fails for want of the requisite minimum percentage of marks prescribed for each individuals paper he/she shall be exempted from re-appearing in such paper (s) in which he / she has secured atleast 25% marks.

7. A candidate who has been declared fail at the Final Year Examination for the degree of Master of Science / Arts, Commerce shall be exempted

from re-appearing in a subsequent year in the following papers :

(a) Where a candidate fails for want of securing the minimum percentage in the aggregate marks, he/she shall be exempted from re-appearing in such paper (s) Practical (s). Dissertation in which he/she has secured atleast 36% marks; provided he/she is passing in atleast 55% of the papers. (Here passing in each paper requires 36% marks).

(b) Where a candidate secures the minimum requisite including dissertation wherever prescribed but fails for want of minimum percentage of marks prescribed for in each individual paper / dissertation, he / she shall be exempted from reappearing in such paper (s) dissertation in which he/she has secured atleast 25% marks provided he/she is passing in atleast 50% of the paper (here passing in each paper requires 25% marks)

M.SC. PREVIOUS BIOTECHNOLOGY
2004–2005

Paper/Practical		Max. Marks
Paper–I :	Biochemistry, Biophysics and Biostatistics	100
Paper–II :	Cytology, Genetics and Molecular Biology	100
Paper–III :	Principles of Microbiology	100
Paper–IV :	Principles and Practices of Plant and Animal Cell Culture	100
Practical–I :	Based on the contents of Paper I & II	100
Practical–II :	Based on the contents of Paper III & IV	100

M.SC. FINAL BIOTECHNOLOGY
2005–2006

Paper/Practical		Max. Marks
Paper–I :	Genetic Engineering	100
Paper–II :	Environmental Biotechnology	100
Paper–III :	Immunology, Enzymology and Microbial Technology	100
Paper–IV :	Applied Plant Biotechnology (Special Paper)	100

PRACTICALS

Practical–I	Based on the contents of Papers I, II	100
Practical–II	Based on the contents of Paper III and special paper (IV).	100

EDUCATIONAL TOURS

Students will visit specialized laboratories, advanced centres, libraries, databases and production facilities, industries each year and will submit an interaction report.

M.SC. PREVIOUS BIOTECHNOLOGY
2004–2005

PAPER–I
BIOCHEMISTRY, BIOPHYSICS AND BIOSTATISTICS

Duration: 3 hrs **M.M.: 100**

UNIT – I

Carbohydrates : General properties, glycolysis, Krebs' cycle, glyconeogenesis, oxidative phosphorylation (mechanism). Pentose Phosphate Pathway. CO_2 fixation (C_3 and C_4 cycles). Photophosphorylation, Photorespiration.

Fatty acids : General properties Synthesis of saturated fatty acids and ß–oxidation, glyoxylate cycle.

UNIT – II

Nitrogen metabolism : Amino acids (general properties and biosynthesis) urea cycle. Protein structure (primary, secondary, tertiary and quaternary), Ramachandran plot, Helicity measurement (CD) hydrophobic and hydrophillic interactions. Alkaloids, Vitamins and Co–enzyme (biological and biochemical functions).

UNIT – III

DNA Protein interactions, elementary account of DNA drug interactions, Transportation across biomembranes: passive transport, facilitated transport, active transport, (Na+ K+ and ATPase pump). Effect of UV and X–rays on nucleic acids.

Introduction to centrifugation, electrophoretic techniques (including isoelectric focusing), tracer techniques, autoradiography, chromatography, spectrophotometry, spectrofluorometry. HPLC, GLC.

UNIT – IV

Brief description of tabulation of data and their graphical representation, measures of central tendency and dispersion: Mean, median, mode, range, standard deviation, variance.

Simple linear regression and correlation.

UNIT – V

Elementary idea of probability, definition and properties of binomial, poison and normal distributions.

Elementary idea of random sampling, selection of simple random samples from a finite population, definition of sampling distribution, sampling variance and standard error.

Idea of two types of errors and level of significance, test of significance, chi–square test of independence and homogeneity test based on Z and T statistics.

Introduction to microcomputers, disk operating system (DOS), elementary idea of statistical computational packages, LAN, E–mail and Internet.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER–II
CYTOLOGY, GENETICS AND MOLECULAR BIOLOGY

Duration: 3 hrs. **M.M.: 100**

UNIT – I

Structure of pro– and eukaryotic cells; membrane structure and function, intra–cellular compartments, protein sorting, secretory and endocytotic pathways; cytoskeleton; mitochondria and chloroplast and their genetic organization.

Nucleus, cell cycle, C–value paradox; chromatin; structure, types, organisation and chemistry of the chromosome. Polytene, lambrush and B–chromosomes. Numerical and structural changes in chromosomes.

UNIT – II

Linkage and crossing over, cytological basis of crossing over, linkage and gene mapping, linked gene inheritances.

Mutation–molecular basis of spontaneous and induced mutations. Their role in plant breeding and evolution. Environmental mutagenesis and toxicity testing, Transposons and their significance. Reverse genetics.

UNIT – III

Classical concepts in genetics.

Genetic material: Structure, chemical composition, organization and replication, reverse transcription, artificial chromosomes, repetitive DNA.

Gene expression; transcription and its regulation in prokaryotes and eukaryotes, genetic code, operon theory; positive and negative control, attenuation and anti–termination controls.

UNIT – IV

The control sequences; operator, promoter, terminator, attenuator, enhancers, cis–acting elements and transacting factors, tissue–specific gene expression, translation.

Recombination: general and site specific recombination; role of Rec A protein, DNA damage and repair.

UNIT – V

Gene transfer in prokaryotes and eukaryotes: natural and artificial methods.

Coding and non–coding sequences, satellite DNA. RNA processing (capping, polyadenylation, splitting, introns and exons). Ribonucleoproteins, structure of mRNA.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10

questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER–III
PRINCIPLES OF MICROBIOLOGY

Duration: 3 hrs. **M.M.: 100**

UNIT – I

Introduction to microbiology – scope and history

Microscopy: Simple light and compound microscopes, phase contrast, dark field, fluorescence and electron (TEM and SEM) microscopy – their principles and applications.

Introduction to concept of asepsis and maintenance of clean area.

Physical (autoclaving, hot air drying, glass bead sterilization, UV – radiation, filter sterilization, ozonization, negative ion generation, air purification) and chemical methods of sterilization, Culture media and methods of their preparation.

UNIT – II

Ultrastructure of bacteria. Broad classification of bacteria. Isolation, cultivation and identification of bacteria, selective culture methods.

Elementary account of most common diseases caused by bacteria in humans, animals and plants.

Nutritional requirements, types and modes of nutrition in bacteria.

UNIT – III

A general account of cyanobacteria – their structure and multiplication. Heterocyst structure and functions.

Role of microbes in carbon and sulphur cycle in nature.

Nitrogen sources and utilization by microbes, nitrogen cycle.

UNIT - IV

Viruses: History, classification and phylogeny, chemical and physical characteristics; virus isolation, purification, cultivation and replication, serology and plaque assay.

Elementary account of most common animal, human and plant disease and their transmission.

Mycoplasma: History, ultrastructure, nutrition, classification, phylogeny, reproduction and methods of cultivation. Elementary account of most common human and animal diseases.

UNIT – V

Elementary account of yeasts, phytoplasma, spiroplasma, L–phase variants, viroids, rickettsias and prions with special reference to most common diseases caused by them.

Microbiology of air, water and soil.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER-IV
PRINCIPLES AND PRACTICE OF PLANT AND ANIMAL CELL CULTURE

Duration: 3 hrs. **M.M.:100**

UNIT – I

Introduction and history of plant tissue culture.

Tissue culture media (composition and preparation).

Initiation and maintenance of callus and suspension culture; single cell clones, somaclonal variation.

Organogenesis; somatic embryogenesis, and clonal propagation transfer and establishment of whole plants in soil.

UNIT – II

Application of plant tissue culture in plant pathology, development of virus free plants, growth of obligate parasites in culture, development of disease resistance, screening of germplasm.

In vitro pollination, embryo culture and embryo rescue.

Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants; symmetric and asymmetric hybrids; cybrids.

UNIT – III

Anther and pollen culture; production of haploid plants and homozygous lines.

Cryopreservation and germplasm conservation.

Gene transfer and transgenic plants; RELP, RAPD and other molecular markers.

Natural products with special reference to alkaloids; production in plant tissue culture; optimization for growth and production, time course of production, extraction of alkaloids and steroids, selection for cells for higher yields, cloning, mechanism of production.

Biotransformation, immobilization, elicitors and hairy root cultures for production of useful metabolites.

UNIT – IV

Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium.

Biology of the cultured cells, measuring parameters of growth.

Basic technique of mammalian cell cultures *in vitro.*

UNIT – V

Microcarrier culture, cell synchronization and cell culture.

Application of animal cell culture.

Hybridoma technology and monoclonal antibodies.

Introduction to the basic techniques and principles of RIA, ELISA, Immunofluorescence microscopy.

Organ and Histotypic culture.

Note:

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M.Sc. (PREVIOUS) PRACTICALS
SCHEME OF PRACTICAL EXAMINATIONS

There will be two practical examinations of 100 Marks each in MSc. (Previous) of 5 hours duration each day (2 days).

Practical-I (Based on Theory Paper I and II)
100 Marks

Practical-II (Based on Theory Paper III and IV)
100 Marks

M.Sc. FINAL BIOTECHNOLOGY
2005–2006

PAPER–I
GENETIC ENGINEERING

Duration: 3 hrs **M.M.: 100**

UNIT – I

History of development of genetic engineering, its principles and basic methods. Restriction endonucleases– their types, classification and application, palindromes and other enzymes needed in genetic engineering.

Cloning vectors: Plasmids – organization, replication and incompatibility of plasmids, construction of plasmid vectors.

UNIT – II

Phages–characteristics of single and double stranded phages, construction of phase vectors, cosmids and other vectors (YAC).

Molecular cloning: construction of cDNA and genomic library transformation, transfection, microinjection, electroporation etc., screening of recombinations, expression vectors, transcriptional reporting.

UNIT – III

Principles and practice of nucleic acid hybridization.

Southern, Northern, Western and South–Western hybridization and gel retardation techniques, DNA–finger printing, chromosome walking.

Sequencing of DNA, chemical synthesis of oligonucleotides, site directed mutagenesis, polymerase chain reaction and its applications, gene replacement and gene and protein targeting.

UNIT – IV

Transposons and their use in genetic manipulation. Retroviruses and retroposons.

Applications of genetic engineering with special reference to agriculture and human health. Medical application of recombinant DNA technology, human disorders associated with defects in proteins and enzymes. DNA probes and their applications in molecular diagnosis of genetic and other human disorders. Health care products.

UNIT – V

Transgenic animals, animal clones – methods of their production, ethics and morality.

Biosafety Regulations: Physical and biological containment.

Intellectual rights, patenting of biological materials, patenting laws in India.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER–II
ENVIRONMENTAL BIOTECHNOLOGY

Duration: 3 hrs **M.M.: 100**

UNIT – I

Global environmental problems: Ozone depletion, UV–B, green house effect and acid rain, their impact and biotechnological approaches for management.

Air, noise and thermal pollution, their causes, harmful effects and control.

UNIT – II

Water pollution and its control. Water as scarce natural resource, need for water management, sources of water pollution, measurement of water pollution, water supply treatment, waste water collection, waste water treatment – physical, chemical and biological treatment processes.

Water purification methods – desalination, reverse osmosis etc.

UNIT – III

Aerobic processes – activated sludge, oxidation ditches, trickling filter, towers, rotating discs, rotating drums, oxidation ponds, anaerobic processes – anaerobic digestion, anaerobic filters.

Treatment schemes for waste waters of dairy, distillary, sugar and antibiotic industries.

UNIT – IV

Environmental biotechnology : Scope and application. Concept of Cleaner Technology.

Solid wastes: Sources and management (composting and methane production) general hazardous wastes, radioactive and other hazardous wastes and their management. Sources and safety.

Application of microbes as biofertilizers and bioinsecticides for productivity improvement and crop protection.

UNIT – V

Principles of biomonitoring and applications of biosensors for detection of environmental pollutants.

Biomining: Use of microbes in biohydrometallurgy and biomineralization.

Bioremediation: Degradation of pesticides, oil spills and other xenobiotics. Phytoremediation of disturbed ecosystems.

Microbes and their genetic engineering for degradation of environmental pollutants.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions)

from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER–III
IMMUNOLOGY, ENZYMOLOGY AND MICROBIAL TECHNOLOGY

Duration: 3 hrs. M.M.:100

UNIT – I

Innate and acquired immunity, clonal nature of the immune response, nature of antigens - antibody structure and function, abzymes, antigen–antibody reactions, major histocompatibility complex, complement system.

Cells of the immune system: B–lymphocytes, T–lymphocytes, macrophages, natural killer and lymphokine activated killer cells.

UNIT – II

Regulation of the immune response, activation of B and T–lymphocytes, Lymphokines, T–cell regulation, MHC restriction, immunological tolerance.

Classification, nomenclature and general properties of enzyme: their isolation, purification and large–scale production.

UNIT – III

Mechanism of enzyme action and regulation; active and regulatory sites; chemical modification, general mechanistic principles, feedback inhibition, isozymes, enzyme activation, zymogens, multienzyme complexes.

Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with special reference to Michaelis–Menten equation. Effects of substrate, temperature, pH and inhibitors of enzyme activity.

UNIT – IV

Isolation, preservation and maintenance of industrial microorganisms, microbial growth and death kinetics, media for industrial fermentation, air and media sterilization.

Types of fermentation processes – analysis of batch, fed–batch and continuous bioreactors, stability and microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulse, fluidized, photobioreactors etc.) Environmental control of bioreactors.

UNIT – V

Downstream processing, whole cell immobilization and industrial applications.

Industrial production of chemicals – alcohol (ethanol), acids (citric acid and gluconic) solvents (glycerol, acetone, butanol), antibiotics (Penicillin, Streptomycin, Tetracycline), amino acids (Lysine, Glutamic acid), single cell protein.

Introduction to food technology – elementary idea of canning and packing, sterilization and pasteurization of food products.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

PAPER-IV
APPLIED PLANT BIOTECHNOLOGY

Duration: 3 hrs. **M.M. : 100**

UNIT – I

Methods of micropropagation and their applications in forestry, floriculture, agriculture and conservation of biodiversity and threatened plants.

Applications of plant biotechnology in breeding and crop improvement – anther, embryo and endosperm culture, production of haploids, somatoclonal and gametoclonal variant selection.

UNIT – II

Production of commercially useful compounds by plant cells. Alkaloids, antitumour agents, saponins and steroids, insecticide additives.

Genetic transformation for production.

Growth of cells in bioreactors, production of active principles, growth in bioreactor, commercialization.

UNIT – III

In vitro approaches to genetic manipulation of plants, application of plant protoplast culture in somatic hybridization and cybridization, current status and commercial opportunities for genetically engineered plants for insect, virus, herbicide and pesticide

resistance, stress tolerance. Antisense RNA technology and its applications. Development of male sterile plants.

Synthetic seeds – Progress and potentials.

UNIT – IV

Scaling–up production and automation in plant propagation. Use of robotics in plant production.

Mass scale plant production facilities: design and planning – clean area, transfer rooms, hatcheries, fogging room, media preparation, storage, dispensation and examination and control.

Production planning and scheduling. Air conditioning, air handling and purification, evaporative cooling, water treatment – softening, demineralization, distillation, reverse osmosis.

UNIT – V

Hardening and acclimatization – success and bottlenecks.

Greenhouse management and operation.

Quality control, packaging and shipment, cost–benefit analysis.

Global market, commercial opportunities in plant tissue culture with special reference to plant tissue culture industries in India.

Note:

The paper setter is required to set questions of 3 types contained in 3 Sections (**Section A-** 10 questions, **Section B**- 10 questions and **Section C**- 4 questions) from the 5 units of each paper. There will be 10 questions in **Section A** which will be asked from all the 5 units, i.e., 2 questions from each unit. These questions have to be answered in one word or a few words only. Each question will be of one mark. All the questions in **Section A** are compulsory. In **Section B,** 10 questions will be set from the 5 units, i.e., 2 questions from each unit. Students are required to attempt at least 1 question from each unit. Each question will carry 10 marks. The answers of each question should be given in about 250 words. In **Section C** there will be 4 descriptive type questions set from all the 5 units, not more than 1 question from each unit. These questions may also have sub-divisions. The students are required to answer 2 questions, each in approximately 500 words. Each question will carry 20 marks .

M.Sc. FINAL PRACTICALS 2005-2006

SCHEME OF PRACTICAL EXAMINATIONS

There will be two practical examinations of 100 Marks in each in M.Sc. (Final) of 5 hours duration each day (2 days).

Practical I

Based on Theory Paper I, II — 100 Marks

Practical II

Based on Theory Paper III and Special Paper (IV) — 100 Marks

Mohanlal Sukhadia University
Udaipur (Raj.)

Syllabus

Scheme of Examination and Courses of Study

FACULTY OF SCIENCE

M. Sc. BIOTECHNOLOGY

Previous Examination : 2004-2005

Final Examination : 2005-2006

Edition : 2004 **Price : Rs.20/-**

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