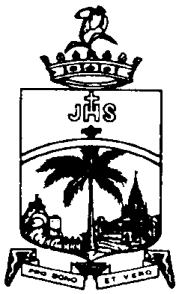
MASTER OF PHILOSOPHY IN BIOTECHNOLOGY

SYLLABUS - 2008-09



ST. JOSEPH'S COLLEGE (AUTONOMOUS)

(Nationally Reaccredited with A+ Grade / College with Potential for Excellence)

TIRUCHIRAPPALLI - 620 002

TAMIL NADU, INDIA

ST. JOSEPH'S COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI - 620 002
DEGREE OF MASTER OF PHILOSOPHY (M. PHIL.)
FULL TIME - AUTONOMOUS REGULATIONS

GUIDELINES

1. ELIGIBILITY

- ✧ A Candidate who has qualified for the Master's Degree in any Faculty of this University or of any other University recognized by the University as equivalent there to (including old Regulations of any University) subject to such conditions as may be prescribed therefore shall be eligible to register for the Degree of Master of Philosophy (M.Phil.) and undergo the prescribed course of study in a Department concerned.
- ✧ A candidate who has qualified for Master's degree (through regular study / Distance Education mode / Open University System) with not less than 55% of marks in the concerned subject in any faculty of this university or any other university recognized by Bharathidasan University, shall be eligible to register for M.Phil. SC / ST candidates are exempted by 5% from the prescribed minimum marks.

2. DURATION

The duration of the M.Phil. course shall be of one year consisting of two semesters for the full-time programme.

3. COURSE OF STUDY

The course of study shall consist of

Part - I : 3 Written Papers
Part - II : 1 Written Paper and Dissertation.

The three papers under Part I shall be :

Paper I : Research Methodology
Paper II : Advanced / General Paper in the Subject
Paper III : Advanced Paper in the subject

Paper I to III shall be common to all candidates in a course. Paper I, II, III & IV shall consist of 5 units each covering the subject requirements of the course offered. The Board of Studies shall approve the Syllabi for Papers. The syllabus for paper IV shall be prescribed by each Research Advisor, which is also to be approved by the Board of Studies. The number of specialized papers by the research advisor can be more than one.

Question papers for Papers I to III shall be set externally and valued by two examiners, one internal and one external. The concerned HOD will be in the Board of Examiners to pass the results. Paper IV shall be set and valued by the Research Adviser. The Controller of Examinations shall conduct the examinations for all papers and dissertation.

4. SCHEME OF EXAMINATION

4.1 Part-I (First Semester)

Paper I : Research Methodology
Paper II : Advanced / General paper in the subject
Paper III : Advanced paper in the subject

Part-II (Second Semester)

Paper IV : Field of specialization
Paper V : Dissertation

4.2 Written Examination

The examinations for Papers-I, II and III shall be taken at the end of the first semester and Paper-IV at the end of the second semester. Each paper shall have 100 marks for the semester examination (written) and 100 marks for Continuous Internal Assessment.

The CIA components are:

Seminar-I	:	15 marks
Mid semester	:	35 marks
Seminar-II	:	15 marks
End semester	:	35 marks
Total	:	100 marks

Both the CIA marks and the external marks should be mentioned separately in the mark sheets. The duration for each semester examination shall be 3 hours. A candidate shall be declared to have passed Part-I & II examinations if he/she secures not less than 50 of the marks each in the CIA and the semester examination respectively. The aggregate of the marks secured in the semester examinations and CIA marks taken together must be 50% in each of the Papers I to IV and Dissertation.

4.3 Credits for Papers I to IV

Paper	Name	Contact Hours	Library Hours	Total Hours	Credits	CIA Marks
I	Research Methodology	6	6	12	10	100
II	Core Subject	6	6	12	10	100
III	Core Subject	6	6	12	10	100
IV	Optional Subject	2	4	6	5	100
	Total			42	35	400

Credits for Dissertation

Internal Examination (the split up for CIA)

Project	Credits	Marks	Total Marks
Seminar on review of related literature	3	30	200
Seminar on Data Analysis / Results	2	20	
Dissertation Evaluation	15	150	
Viva – voce	5	100	100
Total	**25**	**300**	**300**

External Examination

	Credits	Marks
Dissertation Evaluation	20	200
Viva-voce	5	100
Total	**25**	**300**

4.4 Dissertation

For carrying out the dissertation the mandatory requirement is strictly adhering to the rules of the college as given below:

4.4.1a Requirement

Every student is expected to give two seminars one concerning Review of Related Literature within the four weeks from the beginning of the second semester and the other on Data Analysis / Result just before the submission of the final draft of the dissertation

4.4.1b Submission

Candidates shall submit the Dissertations to the Controller of Examination not earlier than five months but within six months in the full time programme. The above said time limit shall start from 1st of the month which follows after the month in which Part-I examinations are conducted. If a candidate is not able to submit his/her Dissertation within the period stated above, he/she shall be given an extension time of three months in the first instance and another three months in the second instance with penalty fees. If a candidate does not submit his Dissertation even after the two extensions, his registration shall be treated as cancelled and he has to re-register for the course subject to the discretion of the Principal. However the candidate need not write once again the theory papers if he / she has already passed these papers.

4.4.1c Requirement

For the valuation of dissertation the mandatory requirement is a pass in papers I to IV. One external examiner and the Research Adviser shall value the Dissertation. The external examiner should be selected only from outside the college and shall be within the colleges affiliated to Bharathidasan University. In case of non-availability, the panel can include examiners from the other university / colleges in Tamil Nadu. The external examiner shall be selected from a panel of 3 experts suggested by the Research Adviser. However, the Controller of Examination may ask for another panel if he deems it necessary. Both the internal and external examiner will evaluate the Dissertation and allot the marks separately. However the viva-voce will be done by both of them. The average marks will be considered.

4.4.2 Viva-voce

The external examiner who valued the Dissertation and the Research Adviser shall conduct the Viva-Voce for the candidate for a maximum of 100 marks. A Candidate shall be declared to have passed in viva-voce if he secures not less than 50% of the marks prescribed for Dissertation and 50% of the marks in the aggregate of the marks secured in viva-voce test and Dissertation valuation. A student can undertake project in the second semester whether or not he /she has passed the first semester.

5. QUESTION PAPER PATTERN

5.1 Internal (Mid & End)

5.1a For Science

There are two sections A and B:

Section A contains 8 short answer Questions	8 × 4	= 32
Section B contains 4 Essay Question	4 × 17	= 68
		100

5.1b For Arts

Only one section of Essay type questions 5 × 20 = 100

5.2 External Exam (Semester)

5.2a For Science

Section A - 10 short answer Questions	10 × 3	= 30
Section B - 5 Essay type Questions either or	5 ×14	= 70
		100

5.2b For Arts

Only one section of Essay type questions 5 out of 8 (5 × 20 = 100)

5.2c For the Paper-IV (Optional/Research Adviser's paper)

The Question paper pattern for Paper IV is common for both Science and Arts. The pattern is only one section with Essay type Questions 5 out of 8 (5 × 20 = 100)

There may be two separate mark sheets for the first and second semester respectively. The marks allotted by the guide and that by the External Examiner must be shown in separate columns of the 2nd Semester mark sheet.

6. CLASSIFICATION OF SUCCESSFUL CANDIDATES

6.1 The candidates who pass the Part - I and Part - II examinations in their first attempt shall be classified as follows:

No.	Total Marks secured in Part - I and Part - II Examinations	Classification
1.	80% and above in the case of Science Subjects & 75% and above in the case of Arts and Social Science Subjects	I Class with Distinction
2.	60% to 79% in the case of Science Subjects & 60% to 74% in the case of Arts and Social Science Subjects	I Class
3.	50% to 59% in all the subjects (Mathematics, Statistics and Computer Science / Applications shall be treated as Science Subjects)	II Class

6.2 Candidates who pass the course in more than one attempt shall be declared to have completed the programme under II Class.

7. QUALIFICATIONS OF RESEARCH ADVISER FOR THE M.Phil. COURSE

7.1 A person eligible to be a Research Adviser shall be required to possess a Ph.D. Degree or two years of Post-Graduate teaching experience after qualifying for M.Phil. / M.Litt. degree. He / She should have obtained recognition from the University.

7.2 In view of the paucity of guides in the newly emerging subjects like Biotechnology, Microbiology, Remote Sensing the research guides in the related areas may be permitted to guide students provided these guides satisfy the qualification requirements.

7.3 Normally a person shall be allowed to guide not more than three candidates.

7.4 Change of guide may be permitted by the Principal based on the merit of the individual cases.

8. ATTENDANCE

- ✧ Daily attendance for 90 working days should be enforced for the students.
- ✧ Periodical report of a student to the guide concerned should be recorded in the register kept by the guide.

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DEPARTMENT OF BIOTECHNOLOGY

ST JOSEPH'S COLLEGE (AUTONOMOUS), TIRUCHIRAPPALLI

M Phil Program - Full Time
(2008 – 09 onwards)

Course Pattern

Semester	Code	Course
I	**08MBT101**	**Research Methodology**
	08MBT102	**Trends in Biotechnology**
	08MBT103	**Drug Dynamics and Design**
II	08MBT204	**Stem Cells and Regenerative Medicine** (OR)
	08MBT205	**Artificial Cell Technology** (OR)
	08MBT206	**Genomics and Proteomics** (OR)
	08MBT207	**Biosafety**
	08MBT215	**Project Dissertation & *Viva Voce* Examination**

Sem- I
08MBT121

Course I: **RESEARCH METHODOLOGY**

Unit-I

Buffers: Characteristics and preparation – pH meter – principles, measurements of pH, pKa. Electrometric determination, glass and reference electrodes. Principles and applications of Clark electrode. Microscopy: Electron Microscope – TEM & SEM and Fluorescence Microscope.

Unit II

Radioisotopes – nature of radioactivity, pattern of decay and half life. Detection and measurement of radioactivity: Autoradiography and applications of isotopes. Spectroscopy - UV/Vis, spectrofluorimetry, IR, NMR, X-ray Crystallography, Mass spectrometry and MALDI-TOF.

Unit III

Chromatography – Basic principles and types- HPLC, Gel filtration, Adsorption and Partition, Ion exchange, Affinity, HIC, IMAC, GLC and TLC. Electrophoresis – principles and types; Capillary electrophoresis, SDS-PAGE, IEF, 2D PAGE and AGE.

Unit IV

Immunotechniques –RIA, ELISA and its variants, western blot. Precipitation reactions – Immuno-diffusion and immune-electrophoresis. Agglutination – Hemagglutination, Bacterial agglutination, Passive agglutination and latex agglutination. Immuno-histochemistry, Flow cytometry and Immuno-electron microscopy.

Unit V

Molecular techniques – Southern, Northern and Dot blot. PCR – Principle, application and types. Gene expression profiling techniques – Microarray. Gene Sequencing – Automated and pyrosequencing. Literature surveying and Review writing

Books

1. Wilson, K and Walker, J (2000) Practical Biochemistry: Principles and Techniques, 5th Edn. Oxford University press, UK.
2. Bernard R Glick and Jack J Pasternak 2001 Molecular Biotechnology - Principles and Applications of Recombinant DNA II Ed. ASM Press Washington DC
3. Maniatis and Sambrook 2003 Molecular Cloning – A Lab Manual Vol I, II & III. Coldspring Harbour Laboratory Press, New York
4. Peter Laake *et al.* (Ed) 2007 Research Methodology in the Medical and Biological Sciences, Academic Press, London

Sem- I 08MBT122

Course II: **TRENDS IN BIOTECHNOLOGY**

Unit I

Plant Biotechnology: Introduction to plant cell and tissue culture and culture media. Initiation and maintenance of callus, suspension, protoplast and root cultures. Organogenesis, embryogenesis and plant regeneration. Plant transformation technology: *Agrobacterium* mediated gene transfer – Ti and Ri plasmids, promoters, reporters and selection markers. Viral vectors, biolistic transformation and electroporation. Applications of plant transformation technology.

Unit II

Animal Biotechnology: Primary and established cell cultures, cell lines and cell strains, growth medium and supplements. Basic techniques of mammalian cell culture and maintenance. Cell synchronization, cloning, micro-manipulation and transformation. Organ and histotypic cultures. Applications of animal cell culture. Transgenic animals – methods of production and applications.

Unit III

Environmental Biotechnology: Waste treatment – classification of treatment processes, treatment of solid wastes, liquid wastes and their types, textile, leather and paper industry effluents. Biodegradation – factors, degradation of hydrocarbons and xenobiotics. Techniques of soil and ground water bioremediation. Biotechnological methods for management of pollution.

Unit IV

Medical Biotechnology: Gene therapy – approaches; DNA based diagnosis of infectious diseases, genetic diseases and DNA fingerprinting. Vaccines – Subunit vaccines, DNA vaccines, and recombinant vaccines. Monoclonal antibodies – production and applications. Assisted reproductive technology – Manipulation of reproduction in animal and in humans.

Unit V

Industrial biotechnology: Bioreactors – types of bioreactors, culture media for bioprocesses, operation of bioreactor, Scale-up and down stream processing. Enzyme technology – Commercial production of enzymes, immobilization of enzymes and cells for production of value added products and biosensors. Biotransformation and microbial production of organic acids, amino acids, foods and beverages.

Books

1. Glick BR and Pasternack JJ (1998) Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2nd edn. ASM press. Washington, USA.
2. Watson JD et al., (2007) Recombinant DNA: Genes and Genomes – A Short course. 3rd edn. Cold Spring Harbor Laboratory press, CSHL, New York, USA.
3. Brown TA (2006) Gene Cloning & DNA Analysis – An Introduction. 5th edn. Blackwell Science Ltd., Oxford, UK.

4. Adrian Slater, Nigel Scott and Mark Fowler 2003. Plant Biotechnology – The genetic manipulation of plants, Oxford University press.

Sem- I 08MBT123

Course III: **DRUG DYNAMICS AND DESIGN**

Objectives

1. *Understand the mechanism of drug biology in human system*
2. *Designing the steps in the process of drug discovery*

Unit I

Drugs – definition, source and nature, classification and nomenclature. Absorption, distribution, bioavailability and bioequivalence of drug products. Pharmacokinetics and pharmacodynamics of drugs in biological systems.

Unit II

Drug metabolism – phase I and phase II biotransformation, microsomal and non-microsomal biotransformation reactions. Drug metabolism in liver, kidney, intestine and placenta. Drug metabolism in infants and aged.

Unit III

Principles and applications of Pharmacogenomics; Genetic factors for variability in drug response and disease susceptibility. Haplotypes and strategies for tag SNP selection, haplotype association studies in pharmacogenomics, HapMap project.

Unit IV

Drug Designing - Introduction to QSAR. Lead module, linear and nonlinear modeled equations, biological activities, physicochemical parameters and molecular descriptors, molecular modelling in drug discovery. Structure Based Drug Design: 3D pharmacophores, molecular docking, *De novo* Ligand design, Free energies and solvation. High-throughput screening in drug metabolism and pharmacokinetic support of drug discovery.

Unit V

Pharmacodynamics, pharmacokinetics of peptide and protein drugs and immunogenicity of protein therapeutics. Biological nano-pores: protein nanopores – maltoporin, nanocontainer – liposome nanocontainers, biopolymer nanocontainers, nanocapsules: applications in drug delivery.

Books:

1. Arthur J. Atkinson Jr 2007, Principles of Clinical Pharmacology Second Edition, Academic Press publications, Elsevier, UK
2. Werner Kalow *et al.,* 2005, Pharmacogenomics II Ed Taylor & Francis, LLC, London.
3. Reza Mozafari, M 2007 Nanomaterials and Nanosystems for Biomedical Applications, Springer, The Netherlands.
4. Elisabeth S. Papazoglou, Aravind Parthasarathy 2007, BioNanotechnology, Morgan & Claypool Publishers.

5. Michael A. Stroscio and Mitra Dutta 2004, Biological Nanostructures and Applications of Nanostructures in Biology Electrical, Mechanical, and Optical Properties, Kluwer Academic Publications, London.
6. Drug Delivery Systems (Methods in Molecular Biology volume 437) 2008 Publisher: Humana Press

Sem- II 08MBT224

Course IV: **STEM CELLS AND REGENERATIVE MEDICINE**

Objectives
1. To understand nature's way of cell perpetuation; and
2. To realise and appreciate the inherent trait of regenerative therapy

Unit I
Stem cells - definition; unique properties – proliferation and differentiation; Potency definitions: totipotent, pluripotent, multipotent and unipotent; basics of early human embryology; History and key stem cell research events

Unit II
Isolation, culture, identification and assays. Types: unlimited and limited; Embryonic and adult stem cells - bone marrow, cord blood, neural, endothelial, hematopoietic, epithelial, pancreatic, hepatic, glandular, cardiac and gastrointestinal, leukemia and cancer stem cells.

Unit III
Stem cells and cloning; germ line stem cells; Recruiting Donors and Banking hES Cells; IPRs and hES Cells. Fate mapping of stem cells in experimental systems.

Unit IV
Genetically engineered stem cells and experimental therapies. Stem cell based therapies: stem cells and repair of heart and nervous system; regeneration strategies. Skin replacement, brain cell transplantation and stem cells in aging

Unit V
Controversies and Guidelines for hES cell research - Scientific background of hESC research; Ethical and scientific concerns; Current Regulation of Human Embryonic Stem Cell Research. Future of SC research.

Books

1. Stewart Sell 2003 (Ed) Stem Cells Handbook, Humana Press, NY
2. Verma IM and Gage FH 2002 (Ed) Regenerative Medicine, Natl Acad Sci & Engg, USA
3. The Natl Academies, USA 2007 Understanding Stem Cells
4. The Natl Academies, USA 2002 Stem Cells and the Future of Regenerative Medicine

5. Stem Cells Info 2008, NIH USA
6. Terese Winslow 2006 Regenerative Medicine, Natl Acad Sci & Engg, USA
7. Marshak *et al.,* 2000 Stem Cell Biology, CSHL press, USA.
8. Regenerative Medicine (2006) NIH, Bethesda, USA.

Sem- II 08MBT225

Course IV: **ARTIFICIAL CELL TECHNOLOGY**

Objectives

1. *Understand the modern advances in the science of synthetic biology*
2. *To comprehend the possibilities and consequences of meddling with life*

Unit I

Artificial cells: Introduction - concept and history, basic features, macro, micro, nano and molecular dimensions. Design of artificial cells: liposomes and nanoparticles; membrane materials; production of artificial cells - microencapsulation technologies.

Unit II

Artificial cells for cell encapsulation - artificial cells in the treatment of liver diseases, kidney diseases, Myocardial infarction, and diabetes. Applications of artificial cells containing genetically engineered cells, stem cells and microorganisms.

Unit III

Enzyme Artificial Cells (EACs) for genetic enzyme defects: Acatalasemia & Phenylketonuria. EACs in substrate-dependent tumors and activation of prodrug. Artificial RBCs as blood substitutes. Artificial cells as novel approach for gene therapy.

Unit IV

Carrier & Artificial-cell mediated drug delivery: Applications in cancer, brain targeting & inflammatory bowel diseases. Current treatment strategies: Microcapsules and nanocapsules. Artificial cells containing bioadsorbants. Artificial organs.

Unit V

Future of Artificial Cells: Cells with lipid-polymer membrane, ion channels and Na-K-ATPase, living artificial cells containing microsomes, cytosol, ribosomes and polymerases. A primer on Synthetic Biology

References

1. Chang TMS (2007) Artificial cells: Artificial Cells and Nanomedicine – Vol. **1**, World Scientific Publishing Co. Pvt. Ltd. 5, Toh Tuck Link, Singapore.
2. Prakash S (2007) Artificial Cells, Cell Engineering and Therapy. Woodhead Publishing Limited, Abington Hall, Abington, Cambridge CB21 6AH, England.

3. Chang TMS (2005) Therapeutic applications of polymeric artificial cells. *Nature Review on Drug Discovery*, Vol. **4**: 221-235.
4. Chang TMS (1997) Blood Substitutes: Principles, Methods, Products and Clinical Trials. Karger AG P O Box CH – 4009 Basel, Switzerland
5. Chang TMS (1972) Artificial Cells. Charles C. Thomas Publishers, Springfield, Illinois, USA.

Sem- II 08MBT226

GENOMICS AND PROTEOMICS

Objectives

1. *Understand the modern science of macromolecular interplay*
2. *Manipulate the data to prediction analysis*

Unit I

Genomes: genome organization, gene structure and expression in eukaryotes and prokaryotes. DNA and chromosome variation – origin of DNA variation: low-copy sequences dispersed repetitive sequences, tandemly repeated sequences, processes that affect genome size.

Unit II

Genome analysis tools: Cloning Systems **-** Plasmid-based vectors, large-insert vectors, BAC libraries – generation & utilization, cDNA Cloning, subtraction libraries. Global gene expression profiling: Differential display, Microarray - DNA and Non-DNA arrays, ChIPs, SAGE, MPSS. Sequencing strategies and automation: physical and genetic maps, MTP sequencing, BAC end sequencing. Marker systems – RFLPs, AFLPs, RAPDs, Microsatellites & SSRs, and SNPs.

Unit III

Methods of fractionating the genome - Expressed Sequence Tags (ESTs), methyl filtration libraries, methylation restriction libraries, transposon tags, COT fractionation-based libraries, and selecting BAC contigs enriched for expressed genes. Gene identification by mutagenesis - insertional mutagenesis, targeting induced local lesions in genomes (tilling), RNAi. Studying gene function through protein-protein interaction.

Unit IV

Proteomics **-** protein isolation, high-throughput protein and peptide separation and detection, protein identification and phosphorylation site analysis by MS, Tandem Mass spectrometry, peptide mass fingerprinting. Protein expression analysis by 2-DE, 2D-MALDI-TOF MS, LC-MS/MS, Quantitative proteomics.

Unit V

Mining the proteome, Protein expression profiling, Identification of protein-protein interaction and protein complexes – Phage display, Yeast two hybrid, three hybrid systems and reverse two hybrids. Protein tags and transgenics, protein arrays, antibody arrays.

Books

1. Cullis. C. A (2004). Plant Genomics and Proteomics, John Wiley & Sons, New Jersey.
2. Grandi .G (2004). Genomics, Proteomics and Vaccines, John Wiley & Sons, England.
3. Liebler .D.C (2002). Introduction to Proteomics: Tools for the new biology, Humana Press, Totowa, New Jersy.
4. Dale. J. W & M.V. Schantz (2002). From Gene to Genomes: Concepts and Applications of DNA Technology, John Wiley& Sons, Ltd. England.
5. Westermeier. R, T. Haven (2002). Proteomics in Practice: A Laboratory Manual of Proteome Analysis, John Wiley & Sons, Ltd., England

Sem- II 08MBT227

BIOSAFETY

Objectives

1. *To study the risk of genetically modified foods and organisms.*
2. *To know the security response and control to meet the risks.*

Unit I

PRINCIPLES OF BIOSAFETY: Advance Informed Consent, Precautionary Principle, Substantial Equivalence, GMO Labelling, Containment, Post-market Surveillance and Evaluation, Control and Management of Risks arising from the use and release of GMOs

Unit II

SAFETY OF FOOD & ANIMAL FEED DERIVED FROM GM CROPS: Nutritional and Toxicological Differences in GM Food; Food Allergies from GM Crops; Fate of Transgenic DNA; Effect of GM Derived Feed in the Food Chain

Unit III

ENVIRONMENTAL IMPACTS: Invasiveness / Persistence; Toxicity to Wildlife; Development of Resistance; New Weed Control Strategies; Horizon Scanning; Changes in Agricultural Practices; Limitations of Science

Unit IV

GENE FLOW AND DETECTION: Gene Flow between Crop Varieties; From GM Crops to Agricultural Weeds and Wild Relatives; From GM Crops to Soil Microbes; From GM Plants Transfer to Viruses

Unit V

GM breeding versus conventional breeding; Deliberate release of GMOs. Risks; Classification of biological risk material. Major risks from GMOs; risk reduction strategies; biological weapons; biosafety level criteria; International treaties and organizations working on biosafety.

Books

1. Eigner WW 1994. Just Technology? CACL, York Univ. Ontario
2. Moe-Wan Ho 1997. Genetic Engineering – dreams or Nightmares? RFSTE/TWN, New Delhi
3. Melchias G 2000. Biodiversity and Conservation. Science Publ. Inc. NH , USA.
4. Mulongo KJ 1997. Transboundary Movement of LMOs, Int. Acad. Envir. Geneva.
5. Pistorius R 1997. Scientist. Planta and Politics. IPGRI, Rome
6. TWN 1996. Biosafety – Scientific Findings and Elements of a Protocol, Malaysia.
7. The UK Govt. 2006 The GM Science Review, London

Sem – II 08MBT228

PROJECT DISSERTATION and *VIVA VOCE*