

SYLLABUS FOR M.SC. IN BIOTECHNOLOGY



Choice Based Credit System (CBCS)

Revised Date : 20th July, 2016

(20th BOS Meeting)



DEPARTMENT OF BIOTECHNOLOGY

Hamdard University, (Jamia Hamdard)

New Delhi 110 062

www.jamiahamdard.ac.in

www.jamiahamdard.edu



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INTRODUCTION

Ranked No. 4 in 2013 amongst the Biotechnology Departments of the Country as per survey of BioSpectrum

VISION OF THE DEPARTMENT

The Department of Biotechnology at Jamia Hamdard, New Delhi was established in the year 1997 with a vision to be recognised as a Department of International repute with a strong interdisciplinary research and teaching base in Plant and Animal Biotechnology with active collaboration of industries and health-care institutions.

INTERNATIONAL/NATIONAL COLLABORATIVE PROGRAMME

- Indo-US Vaccine Action Programme with Emory University, USA.
- Centre for Disease Control for Disease Control, (CDC), USA on infectious diseases.

CENTRE FOR TRANSGENIC PLANT DEVELOPMENT :

The department also has a Centre for Transgenic Plant Development with state of art facilities for gene cloning, delivery and expression in microbes and plants aimed at improving their productive and qualitative traits. Three post-doctoral students are also working in the Centre for Transgenic Plant Development.

RESEARCH AREAS

- Development of biomolecules by r-DNA technology.
- Regulation of gene expression.
- Development of diagnostic tests.
- Vaccine development.
- Molecules virology (Human viruses).
- Genomics/ Proteomics of cancers and development of biomarkers for their early detection
- Molecular biology of non-infectious diseases.
- Proteomics of host-pathogen interactions.
- Enhancement of secondary metabolites through genetic engineering and *in vitro* culture, metabolic engineering of medicinal plants for better yields of medicinal compounds.
- *In vivo* and *in vitro* conservation of medicinal plants.
- Transgenics of vegetables, floriculture and oil crops.

EXTRAMURAL RESEARCH FUNDING

The Department has received extramural Research Funding in the form of Twelve Research Project sponsored by DBT, DST, CSIR, ICMR, ICAR, DRDO, UGC, DOEn, ISM&H, CCRUM, AYUSH, and World Bank with a total grant of Rs 497 Lakh

Professor M.Z. Abdin

Head , Department of Biotechnology
Head, Centre for Transgenic Plant Development
Chairman, UGC-SAP



Professor M.Z. Abdin was born in the village, Quadirabd, Dist. Sidhartha Nagar, Uttar Pradesh in June 1963. After his primary education in Quadirabad, Professor Abdin moved to Utroula and Basti for college education. He graduated from Aligarh Muslim University, Aligarh, U.P. in 1985 in Botany and did Ph.D. in Plant Physiology from Indian Agricultural Research Institute (I.A.R.I.), New Delhi in 1991. In the last year of his Ph.D. programme, Professor Abdin was selected for lectureship in the Department of Botany in Jamia Hamdard, New Delhi and joined this position in 1990. In 1997, he was appointed as Reader and in 2005 as Professor in the Department of Biotechnology in Jamia Hamdard, New Delhi. He also took over Vice-Chancellor of Singhania University, Rajasthan in the year 2008. However, due to his strong interest in Research, Professor Abdin returned back to his parent Department Biotechnology. In addition to having many administrative positions in Jamia Hamdard including Dean, Faculty of Science, Member of Executive Council and Jamia Hamdard Society, he is currently Head, Department of Biotechnology and member, Executive Council, Integral University, Lucknow, U.P. So far he has guided 37 Ph.D. students as supervisors and 19 as Co-Supervisors in the area of Biotechnology. Professor Abdin has published more than 138 original research papers and edited two books. He has also visited several countries including U.S.A., France, Germany, Japan, Australia, China, Saudia Arabia and Iran to deliver lectures in International conferences.

Awards

- 1) **2014** : **“Vigyan Ratan Award”** for the year 2011-12 for the significant scientific achievements in the field of Biotechnology by Uttar Pradesh Council for Science & Technology (U.P.C.S.T), Govt. of Uttar Pradesh, UP, India.
- 2) **2011** : **BioSpectrum Public-Private Partnership Excellence Award** by BioSpectrum, 134 Infantry Road, Bangalore, India.
- 3) **2004** : **Conferred Senior Award for the year - 2004** by the Academy for Advancement of Agricultural Sciences, Indian Agricultural Research Institute, New Delhi, India.
- 4) **2004** : **Conferred Distinguished Scientist of the Year - 2004 Award** by National Environmental Science Academy (NESA), New Delhi, India.
- 5) **2004** : **Conferred Eminent Scientist Award** by Health Fitness Trust, New Delhi, India.

ADMINISTRATION

Academic Staff

| S.No | Name | Designation | Specialization |
|-------------|---------------------------|--------------------|--|
| 1 | Dr. M.Z. Abdin | Professor & Head | Plant Biotechnology |
| 2 | Dr. Pratima Ray | Professor | Molecular Virology, Vaccinology |
| 3 | Dr. Pradip K. Chakraborti | Professor | Molecular Biology |
| 4 | Dr. Alka Narula | Asst. Professor | Plant Biotechnology |
| 5 | Dr. Humaira Farooqi | Asst. Professor | Protein Biochemistry and Stress Biology |
| 6 | Dr. Saima Wajid | Asst. Professor | Clinical Genomics and Proteomics, Molecular Oncology |

ADMINISTRATIVE AND TECHNICAL STAFF

| S.No | Name | Designation |
|-------------|-----------------------|--------------------------|
| 1 | Mr. Anish Cherian | Dealing Assistant |
| 2 | Ms. Noor Fatima | Technical Assistant |
| 3 | Ms. Sarika Chouksey | Technical Assistant |
| 4 | Mr. Syed Naved Quadri | Research Assistant |
| 5 | Mr. Mubarak Kahn | Lab Assistant |
| 6 | Mr. Diwan Mohammad | Office cum Lab Attendant |
| 7 | Mr. Satish Chand | Lab Attendant |
| 8 | Mr. Shafuddin | Lab Attendant |
| 9 | Mr. S. Zafar Nazish | Lab Attendant |
| 10 | Mr. Islamuddin | Office-cum-Lab Attendant |

STUDENTS SUPPORT FACILITIES

HERBAL GARDEN

Jamia Hamdard has the privilege of maintaining a herbal garden within the campus which has about 150 species of important traditional medicinal and aromatic plants. The main purpose of the garden is to carry out experimental work and initiate the ex-situ conservation of rare medicinal plants. It also helps in various research projects by providing raw material.

CENTRAL INSTRUMENTATION FACILITY (CIF)

The faculty has a well-equipped Central Instrumentation Facility which is open to all the students round the clock. It is equipped with state-of-art equipments. These include Atomic absorption and Atomic emission spectrophotometers, inductively coupled plasma spectrophotometer, ELISA reader, JASCO Spectro-polarimeter, Ultracentrifuges, HPLC with integrator, Gas chromatograph, HPTLC, CHNS Analyser, Gamma and Beta Scintillation Counters, Ultrascan, FT-IR, Luminescence Spectrometer, UV-VIS Double Beam Spectrophotometer, Gel Documentation System and Semi-preparative HPLC. Facilities for Internet and DTP are also available. All the Departments of the faculty are connected to the server of the CIF.

HAKIM MOHAMMED SAID LIBRARY

Jamia Hamdard Library and Information System consists of a Central Library and six Faculty libraries. Total library holdings are 2,06,000 including 1,79,000 books, 19,000 bound volume of periodicals, 35,000 rare books, 4,000 manuscripts, 3,750 Theses/Dissertations, 375 microfilms, 584 microfiches, etc. The Central Library subscribed 47 current print journals, 13 online journals and 02 electronic data bases (ACM & IEEE) on Science, Pharmacy, Medicine, Management, Nursing, Information Technology etc. The Library has its own binding and preservation facilities also. The Central Library and three Faculty libraries are fully computerized and connected with Local Area Network (LAN). The Central Library has developed database of books, journals, Theses/Dissertations and CDs, which can be accessed through the On-line Public Access Catalogue

(OPAC) by the library users. Outside Campus, users can also access the library database through the Web OPAC service. The registered library users are issued bar-coded library membership cards for quick electronic borrowing of library materials from any of the libraries besides the HMS Central Library. Library has developed a portal entitled "Digital Information Centre" attached to the Library website, which provides access to free journals, e-journals database of INFLIBNET and many national and international database of DELNET. The IP based access to a large number of pharmacy, medical and science journals is providing a boon to the students and faculty members from a variety of large number of academic and research background. The journal database is also facilitating the users a great deal. The Book Bank and the Textbook Reference Sections are meeting the requirements of the students for reading materials. The inter-library loan (ILL) facility is being provided to the library members through the DELNET. The library has a good collection of Urdu, Arabic and Persian books. The unique feature of the library is the development of a computerized database of these books. At present, a database of more than 39,000 of such books has been developed. The university website www.jamiahamdard.edu may be visited for further details about library resources, library rules etc.

COMPUTER CENTRE

Information Technology has become increasingly crucial to effective acquisition and dissemination of knowledge. Therefore, Computer professionals in Jamia Hamdard are adopting best practices for integrating these technologies in support of teaching and learning. All the faculties, libraries, laboratories located in different buildings as well as Majeedia Hospital and Administrative Block are connected through 1 GB fiber Optic cables. Many Computer laboratories have been set up in various faculties and all the students are encouraged to make extensive use of these facilities.

UNIVERSITY WEBSITE

<http://www.jamiahamdard.edu> is the main resource of information about the University. Starting with the announcement of the admission, list of short listed candidates, regular notices are uploaded on the web site.

MAJEEDIA HOSPITAL

Majeedia Hospital is a multi specialty, 150 bedded hospital under expansion to 450 beds. Situated in the green campus of Jamia Hamdard it provides excellent professional care to the patients in Accident and Emergency services, Out Patients, In-patients through a dedicated team of medical experts along with latest technology at affordable cost both in Allopathic and Unani system of medicine. It has consultants of Medicine, Surgery, Paediatrics, Obst. & Gynae, Orthopaedics, Dermatology, Dental Surgery, ENT, Ophthalmology, Ultrasonologist, Speech therapy and Anaesthesia. Super speciality facilities in the fields of Urology, Maxillo Facial Surgery, Cardiology, Endo-Crinology, Plastic Surgery, Echo Cardiology, Nephrology, Psychiatry, Pulmonology, Obst. & Gynae Infertility, Gastroenterology are also available. The Hospital has round the clock services of ICU, Neonatal ICU, Laboratory, Emergency, Pharmacy, Ambulances, Dialysis, X-Ray and Ultrasound. Majeedia Hospital also provides services like TMT, Echo cardiography, Audiometry, EEG, PFT, NCS and EMG. Senior and highly experienced Doctors provide out-patient consultation. Investigation in the field of Microbiology, Pathology, Biochemistry, Radiology, Ultrasonology are available. Majeedia Hospital has collaboration with PSRI for Blood Bank facilities and is empanelled with MRI Diagnostic & Research Centre for CT and MRI facilities. A Centre for Rehabilitation Medicine provides excellent care in the field of Occupational Therapy and Physiotherapy. Family Welfare Department provides facilities of Community Health, Immunization and Family Planning Services with the assistance of Delhi Government. The hospital is the nodal institution for conducting courses of M.Pharm (Pharmacy Practice), B.Sc. Medical Laboratory Techniques, Diploma in X-ray and ECG Techniques, Diploma in Dialysis Techniques, Diploma in Operation Theatre Techniques and Diploma in Medical Record Techniques.

HEALTH CARE

Students of Jamia Hamdard are eligible for free consultation in allopathic and Unani OPDs. Emergency services to students are also provided free of cost. Cost of medicine has to be met by the students.

HAMDARD CONVENTION CENTRE

Beautifully designed and centrally air-conditioned Convention Centre has attracted scholars, researchers and organizations from all over the world. It is elegantly furnished and provided with all the modern amenities for organizing seminars, conferences, meetings and lectures.

HOSTELS

University has following seven hostels for boys and girls:

1. Sultana Razia Hostel - UG and PG girls
2. Rufaida School of Nursing Hostel - Nursing students.
3. Anne Marie Schimmel Hostel - PG girls
4. Al-Biruni Hostel - UG boys
5. Ibn-Sina Hostel – UG and PG girls
6. Ibn-e-Batuta Hostel – PG Boys
7. Jawaharlal Nehru International Hostel – Boys.

SPORTS AND CULTURAL ACTIVITIES

Jamia Hamdard has a well-equipped gymnasium and other sports related facilities. There are two indoor badminton courts, two table-tennis tables, billiard table and a hard tennis court. There are playgrounds for cricket, football, basketball and volleyball. The University organizes sports and cultural week every year for the students where inter-faculty competitive sports and cultural events are held.

NATIONAL SERVICE SCHEME (NSS)

National Service Scheme is a programme sponsored by the Ministry of Youth Affairs and Sports, Government of India. Since its inception, NSS has enrolled students from all the faculties. The NSS volunteers participate in various awareness programmes such as Pulse Polio Immunization camps, awareness about Hepatitis-B, DPT and BCG immunization, HIV/AIDS, STD, importance of cleanliness, illiteracy eradication programme, plantation and related activities. NSS volunteers also participated in a project sponsored by UNICEF on polio immunization. NSS volunteers organize Blood donation camp every year A 15 day Special camp is organized by NSS volunteers every year in different slums of Delhi for community awareness programme. NSS Jamia Hamdard is a member of Red Ribbon Club which is HIV/AIDS awareness scheme sponsored by Delhi Government.

NATIONAL CADET CORPS (NCC)

NCC unit of Jamia Hamdard is affiliated to 7 Delhi Battalion, New Delhi. Besides routine drills, NCC cadets participate in several welfare programmes such as blood donation camps and immunization programmes.

STUDENTS AID FUND

The University has allocated some amount as Students Aid Fund which is meant for financial help to the needy students. A student, whose parents/guardians have income of less than Rs.10,000/- per month along with his/her performance at examinations conducted by Jamia Hamdard is eligible for applying for the assistance from this fund.

PLACEMENT CELL

To facilitate the placement and summer training of M.Sc. Biotechnology passing-out and passed-out batches in R&D institutions, Universities and Industries a Placement Cell was established by the HoD, Prof. M.Z. Abdin in Department of Biotechnology in 2014. The coordinators of the cell are Dr. Humaira Farooqi and Dr. Saima Wajid.

First round of placement interview with the company AceProbe Technologies (I) Pvt Ltd was conducted on 21/4/2014. They interviewed around 24 M.Sc. final year students and selected two students Mr. Nadeem Sardoiwala and Mr. Azhar Andrabi as regular employees. They have joined the company.

On 30th April, 2014, Dept. of Biotechnology organized the second round of campus interview with Double Helix Clinical Cytogenetics & Reproductive Immunology Centre to our final year students. The team from the company conducted the initial screening of the sixteen students and selected three students, Mr. Kailash Singh, Md. Islammudin and Mujeeb for employment.

On 3rd February, 2015, 10 final year students were sent to Genetix Biotech Asia Ltd. The team from the company conducted the interview of the Ten students and selected two students, Ms. Juwariah Khan and Ms. Pooja Chhikara for employment.

The students who have passed out from this department have been selected in various institutions including DRDO, CSIR laboratories, universities (Delhi University, Guru Gobind Singh University, Kashmir University, etc), medical colleges such as PGIMER (Chandigarh), and industry. Many opt for the PhD, and have been taken by premier institutes and research laboratories such as CCMB (Hyderabad), IISc (Bangalore), ICGEB (New Delhi), AIIMS (New Delhi), NII (New Delhi), Dabur Research Foundation (Ghaziabad), NICD (New Delhi), NCBS (New Delhi), CDRI (Lucknow), TERI (New Delhi), IARI (New Delhi), JNU (New Delhi), DU, South Campus (New Delhi), IGIB (New Delhi), CDFD (Hyderabad) and laboratories abroad in USA, Germany, and Denmark.

NET COACHING CLASSES

Department organizes NET coaching classes for the M.Sc. Biotechnology students under the guidance of Head, Dept. of Biotechnology. The Coordinators are Dr. Alka Narula, Dr. Humaira Farooqi. The NET coaching classes are held on Saturdays from 9.00 AM to 1.00 PM. These classes are taken by the teachers from the Dept. of Biotechnology and also from other departments of Faculty of Science as well as outside experts. M.Sc. students are asked to submit those topics where they need coaching and to be discussed during NET coaching classes.

ALUMNI ASSOCIATION

Department has established an Alumni Association. Passing-out and passed-out batches have to submit the prescribed application form in the Office of the Biotechnology for registration in the Association. A webpage has already been created for Alumni Association. The coordinators of Alumni Association are Dr. Humaira Farooqi and Dr. Saima Wajid.

SCHOLARSHIPS & FELLOWSHIPS

The following scholarships / fellowships are available for the students.

General for all Faculties

- a) Hamdard National Foundation (HNF) Scholarship For limited PhD. students on the merit-cum-means basis.
- b) Khwaja Moinuddin Chishti Ajmeri (Gharib Nawaz) merit-cum-means scholarship to be awarded on the basis of essay writing competition on the life and work of Khwaja Gharib Nawaz.
- c) Dr. L.M. Singhvi Gold Medal (or Silver Shield) of accolade for the first and second winner of essay competition on a subject of topical importance of interfaith dialogue conducted every year.
- d) Hakeem Abdul Majeed Scholarship (for Pharmacy, Medicine (U), Nursing and Science Faculties) for the students who have secured highest marks in annual exams of B.Pharm. or B.Pharm. (Unani) I, II and III Years (Under regular scheme), BUMS I & II Prof., B.Sc. Nursing, I, II and III Years and M.Sc. I Year.

Faculty of Science

- a) Mrs. Shakila Naqvi Merit Scholarship For a (Muslim) female student of M.Sc. II year who secures highest marks in M.Sc. I Year of Faculty of Science.
- b) Tasmia Merit Scholarship For a student of M.Sc. II year Biotechnology on the basis of merit of the candidate.
- c) Noorul Hasan Memorial Scholarship For a student of II year of M.Sc. Biotechnology on the basis of merit and need.
- d) Prof. A.K.M. Ghouse Means-cum-Merit Scholarship For a student of M.Sc. II Year Botany (Environmental Botany), on the basis of merit.
- e) Anchrom Means-cum-Merit Scholarship For a student of M.Sc. II Year Chemistry (Industrial Applications) on the basis of merit of the candidate.
- f) Dr. Manoj Varshney Scholarship For a student of M.Sc. II Year Chemistry (Industrial Applications) on the basis of merit.
- g) Khalil Ahmad Merit-cum-means Scholarship For a student of M.Sc. Chemistry on the basis of merit and need.
- h) Late Mr C.R. Arora Scholarship For a meritorious and needy student of M.Sc. Chemistry (Industrial Chemistry) Final year.
- i) Hind Agro Industries Merit Scholarship For a student of M.Sc. II year Toxicology on the basis of merit-cum-financial need of the candidate.
- j) Tasneema Fellowship For a female student of M.Sc. II Year (Toxicology) for studies on Regulatory Toxicology
- k) Late Hajji Mohammad Asif (s/o late Janab Mohammad Ishaque Sandook Wale, 1319, Pahari Imli, Delhi-6) Reward for knowledgeable student (MARKS) Scholarship For bonafide Muslim student / students of MSc (either in Biochemistry, Biotech, Chemistry-Industrial Applications, Environmental Botany or Toxicology) for II year.

BOOKS FOR REFERENCES

| | | |
|----------------------|---|----------------------|
| • William S.Klug | Concepts of Genetics | Pearson |
| • D.S. Rao | Bioinformatics | Biotech |
| • Slater | Plant Biotech the Genetic Manipulation of plant | Oxford |
| • Lewin's | GenesX | Jones & Bartlett |
| • S.J. Vennison | Laboratory manual for Genetic Engineering | PHI |
| • M.R. Winfrey | Unraveling DNA | Pearson |
| • Thieman | Introduction to Biotechnology | Pearson |
| • S.Shanmugam | Enzyme Technology | I.K. International |
| • A.K. Chauhan | A Textbook of Molecular Biotechnology | I.K. International |
| • A Mukhopadhyay | Animal Cell Technology | I.K. International |
| • A.S. Mathuriya | Industrial Biotechnology | Ane Books |
| • Albert et al | Essentials Cell Biology, 3rd Edition. | Garland Science |
| • Bruce Albert | Essentials Cell Biology, 3rd Edition. | Garland Science. |
| • Cosmatos | BioStrategies and Statistical Methods | CRC |
| • David P. Clark | Biotechnology: Applying the Genetic Revolution | I.K. International |
| • HS Chawla | Introduction to Plant Biotechnology | Oxford University |
| • John M. Shriver | Protein Structure Stability and Interactions | Human Press |
| • Jyotsna Rathi | Microbial Biotech and Applied Microbiology | Manglam |
| • Mouer | Environmental Biotechnology | Elsevier |
| • Neumann KH | Plant Cell and Tissue Culture | Springer |
| • Nobel | Physicochemical & Environmental Plant Physiology | Elsevier |
| • Pevsner | Bioinformatics & Functional Genomics | Wiley-Blackwell |
| • Portner | Animal Cell Biotechnology : Methods and Protocols | Cambridge University |
| • R.K. Sharma | Basic Techniques in Biochemistry & Mol. Biology | Chapman & Hall |
| • Rob Phillips | Physical Biology of the Cell, Second Edition. | Garland Science |
| • Templeton | Gene and Cell Therapy | CRC |
| • Tewarie Lakhanpal | Microbial Biotechnology | Sarup |
| • Thomson | Modeling Demographic Processes in Populations | Springer |
| • William S. King | Concept of Genetics | Person Education |
| • Basant K Sinha | Principles of Animal Cell Culture | IBDC |
| • Benjamin Lwein | Genes IX | Jones & Bartlett |
| • Bowers | Medical Statistics from Scratch | Wiley & Sons |
| • C. Neal Stewart JR | Plant Biotechnology and Genetics | John Wiley |
| • C.A. Reddy | Methods for General ad Molecular Microbiology | ASM |
| • Das | Environmental Biotechnology | Daya |
| • David L. Nelson | Principles of Biochemistry, Fifth Edition. | W.H. Freeman |
| • David S. Latchman | Eukaryotic Transcription Factors | Elsevier |
| • Janeways | Immuno Biology, 7th Edition | Garland Science |
| • John M. Walker | Molecular Biomethods Handbook | Humana Press |
| • John Wilson | Molecular Biology of the Cell-The Problem | Garland Science |
| • Kuby | Immunology, 6th Edition | Lippincott Williams |
| • L. James D Berk | Molecular Cell Biology | W.H. Freeman |
| • Nelson David L | Lehninger Principal of Biochemistry | W.H. Freeman |
| • Richard A. Harvey | Immunology- Illustrated Reviews | Lippincott Williams |
| • Robert J. Henry | Plant Genotyping II SNP Technology | CABI |
| • Veer Bala Rastogi | Fundamentals of Biostatistics, 1st Edition | Ane Books |

Group name : jhbiotech

Description: A group meant for ex- and present students/members of Department of Biotechnology, Jamia Hamdard (Hamdard University) New Delhi, India. The group is essentially meant to exchange only the academic information. All are requested to join this group.

Group current web address:

<http://groups.google.co.in/group/jhbiotech>

You must be signed in and a member of this group to view its content.

- Copy the above link and paste in address bar and press enter then
- Sign in with any of your email address in Google group then
- Sign in and apply for membership

Group Current email address:

jhbiotech@googlegroups.com

For any queries please contact (Mr. Anish Cherian):

jamia.biotechnology@gmail.com

CHOICE BASED CREDIT SYSTEM (CBCS) - 2016

| SEMESTER – I | | | | | | | |
|----------------------|---|-----------------------------|-----------------|----------------|------------------|------------------|-------------------|
| Course Code | Course Name | Paper Category | Duration | Credits | Max Marks | Sessional | Exam Marks |
| MFC 001 | Foundation Course | Compulsory Course | 200 hrs | 8 | 200 | 50 | 150 |
| MBT OE101 | Cellular Biology & Biomolecules | Open Elective | 72 hrs | 4 | 100 | 25 | 75 |
| MBT CC102 | Molecular Biology | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 144 hrs | 4 | 100 | 25 | 75 |
| MBT CC103 | Essentials of Genetic Engineering | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 144 hrs | 4 | 100 | 25 | 75 |
| Total | | | | 28 | 700 | 175 | 525 |
| SEMESTER – II | | | | | | | |
| Course Code | Course Name | Paper Category | Duration | Credits | Max Marks | Sessional | Exam Marks |
| MBT CC201 | Expression of Genetic Information | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 108 hrs | 3 | 75 | 15 | 60 |
| MBT CC202 | Molecular Plant Physiology | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 108 hrs | 3 | 75 | 15 | 60 |
| MBT CC203 | Plant Tissue Culture & its Applications | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 144 hrs | 4 | 100 | 25 | 75 |
| MBT CC204 | Biotechnology : Environmental & Ethical Aspects | Core | 72 hrs | 4 | 100 | 25 | 75 |
| MBT OE205 | Biostatistics | Open Elective | 72 hrs | 4 | 100 | 25 | 75 |
| MBT DE206 | Seminars/ Assignments | Discipline Centric Elective | 36 hrs | 4 | 100 | 0 | 100 |
| Total | | | | 34 | 850 | 180 | 670 |

CHOICE BASED CREDIT SYSTEM (CBCS)

| SEMESTER – III | | | | | | | |
|-----------------------|--------------------------------|-----------------------------|-----------------|----------------|------------------|------------------|-------------------|
| Course Code | Course Name | Paper Category | Duration | Credits | Max Marks | Sessional | Exam Marks |
| MBT CC301 | Animal Biotechnology | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 108 hrs | 3 | 75 | 15 | 60 |
| MBT CC302 | Plant Biotechnology | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 144 hrs | 4 | 100 | 25 | 75 |
| MBT CC303 | Immunology | Core | 72 hrs | 4 | 100 | 25 | 75 |
| | Practical | | 108 hrs | 3 | 75 | 15 | 60 |
| MBT CC304 | Biotechnology and Human Health | Core | 72 hrs | 4 | 100 | 25 | 75 |
| MBT OE305 | Bioinformatics | Open Elective | 100 hrs | 4 | 100 | 25 | 75 |
| MBT DE306 | Seminars/Assignments | Discipline Centric Elective | 100 hrs | 4 | 100 | 0 | 100 |
| Total | | | | 34 | 850 | 180 | 670 |

| SEMESTER – IV | | | | | | | |
|----------------------|--------------------|-----------------------|-----------------|----------------|------------------|------------------|-------------------|
| Course Code | Course Name | Paper Category | Duration | Credits | Max Marks | Sessional | Exam Marks |
| MBT CC401 | Project/ Viva voce | Core | 720 hrs | 20 | 500 | 100 | 400 |
| Total | | | | 20 | 500 | 100 | 400 |

- One Practical/ Tutorial credit is gained by two hours
- For Open Elective papers candidate has to compensate for the required credits per semester (25) if he/she chooses the elective paper from any other Department of Science Faculty
- One Open Elective each for first three semesters is proposed, therefore 9 credits may be gained from any other Department of Science Faculty

FOUNDATION COURSE

MFC 001

Credit :8, Max. Marks: 200 [Sessional Marks: 50, Exam. Marks: 150] Time :200 hours

CHEMISTRY (Unit-I)

Essential :

1. Solution – Methods of expressing the concentration (Molality, Molarity, Normality, etc.), Colligative properties, Molecular mass determination using colligative properties, basics of Nanotechnology.
2. Rate of reaction, order of reaction, molecularity of reaction.
3. Ionic or Electrovalent bond, Covalent bond, Types of overlapping and nature of covalent bonds, Hybridization, examples of Sp^3 , Sp^2 and Sp Hybridization, Co-ordination bond, Hydrogen bonding.
4. Principle of Chromatography, Classification of chromatographic techniques, TLC and paper chromatography, Application of chromatography.
5. Basics of Spectroscopy and applications.

Desirable :

1. Laws of mass action, Reaction Quotient, Chemical equilibrium constant, Relation of K_p & K_c , pH, buffer, buffer index, buffer capacity, Arrhenius equation & Nanotechnology.
2. Principles and applications of GC, HPLC, Ion exchange and Size exclusion chromatography
3. Principles of UV/VIS, IR and NMR Spectroscopic techniques and applications
4. Synthesis and applications of Nanoparticles

BIOCHEMISTRY (Unit-II)

Essential :

1. **Biomolecules** : Carbohydrates, amino acids/proteins, lipids and nucleotides; Enzymes: Characteristics and nomenclature.
2. **Cell Biology & Microbiology** : Prokaryotes & Eukaryotes: The cell and its composition; Cell organelles and subcellular fractionation; Viruses, Viroids, Virusoids and Prions; Bacterial culture and growth curve.
3. **Bioenergetics and Intermediary Metabolism** : ATP as energy currency; Intermediary metabolism;
4. **Immunology** - Active, passive, Humoral and Cellular immunity; Clonal selection theory; Cells of immune system; Immunoglobulins; Haptens, Antigens and Immunogens; Monoclonal & Polyclonal antibodies.

Desirable :

1. **Gene transfer Mechanisms in bacteria & Gene expression** : Conjugation, Transformation and Transduction; expression of eukaryotic genes in prokaryotes.
2. **Clinical Biochemistry** :Biochemical tests; Quality assurance; Acid base disorders; Liver function test; Kidney function tests.
3. **Glucose Metabolism** - Glycolysis and TCA cycle; oxidative phosphorylation; Aerobic & anaerobic Fermentation.
4. **Hybridoma technology**.

BOTANY (Unit-III)

Essential :

1. **Biodiversity** – Concept, levels and Conservation of biodiversity
2. **Climate Change** – Consequence, CO₂ fertilization, global warming, sea level rise, UV radiation.
3. **Ecosystem** - Producers, consumers and decomposers of food chain.
4. **Natural Resources** - Renewable and non-renewable resources of energy.
5. Plant drugs and their constituents used in allopathic system of medicine.

Desirable :

1. **Environment** - International efforts and India initiatives in biodiversity conservation, Endemism, biodiversity hotspots; bioremediation, Bioindicators, green house gases (trend and role), ozone layer and ozone hole; Environmental pollution;
2. Toxic and poisonous plants, Petrocrops and energy plantation
3. Plant breeding and crop improvement (wheat, cotton, *Brassica*)

BIOTECHNOLOGY (Unit-IV)

Essential:

1. **Genetics of Inheritance** - Laws of inheritance, recombination and segregation of traits, segregation ratio, interaction between traits & quantitative inheritance.
2. **Molecular Biology** - The genetic material, RNA as genetic material, fidelity of DNA replication, transcription, translation, gene regulation. Mutation and mutagenesis, Ames test, Transposons.
3. **Genetic Engineering** - Essentials of gene manipulation, vectors & enzymes used in recombinant DNA technology.

Desirable:

1. **Applications** - Stem cell research and its application, disease tolerant plants, insecticide and herbicide tolerant plants, increasing the shelf life of vegetables and fruits, improvement in quality (golden rice) and quantity of produce.
2. **Biotech and Society** - Apprehensions for GM crops-effect on ecosystem, loss of genetic base, loss of diversity, IPR concerns, adaptation, judicious implementation.

TOXICOLOGY (Unit-V)

Essential :

1. **Introduction to Toxicology :**
 1. Various types of toxicity (Acute, subacute, subchronic and chronic).
 2. Chemical interactions (Additive effect, potentiation, synergism and antagonism), Dose response relationship (ED₅₀, LD₅₀ EC₅₀, LC₅₀.)
 3. Routes of exposure, absorption, distribution, elimination. In vitro and in vivo models in toxicological studies.
2. **Metabolism of Xenobiotics** : Common toxicants of air, water & food – metabolism & their impact on human health.
3. Concept and requirement of Good Laboratories Practices (GLP), GMP, GCP.

Desirable :

1. Tumor Markers
2. Chemical carcinogenesis & dietary intervention
3. Enzyme inhibitor

CELLULAR BIOLOGY & BIOMOLECULES

MBT – OE101

Credit :4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time: 72 hours

Subject Coordinator : Dr. Humaira Farooqi

UNIT – I

The cell & cell cycle: Structure and function of cell. Phases of the cell cycle; regulation of the cell cycle by cell growth and extra cellular signals; cell cycle check points; coupling of S-phase to M phase. Regulators of cell cycles progression – MPF; families of cyclins and cyclin – dependent kinases; growth factors and D-type cyclins. Inhibitors of cell cycle progression. Cell growth and division.

Cell Signaling: Signaling molecules and their receptors; functions of cell surface receptors; pathways of intracellular signal transduction; signal transduction and the cytoskeleton; signaling in development and differentiation. Bacterial Chemotaxis and Quorum Sensing; Cell signaling and Cancer.

UNIT –II

Carbohydrates& Lipid Metabolism:

Carbohydrates: Structures and functions of carbohydrates ; Bioenergetics, glycans and proteoglycans. Aerobic and anaerobic pathways. Glycolysis, TCA cycle, electron transport chain and oxidative phosphorylation. Galactose and fructose metabolism. Gluconeogenesis, glycogen synthesis and breakdown.

Lipids: Structure and functions; Metabolism and synthesis of phospholipids, glycolipids, sphingolipids and other derived lipids. α , β and ω oxidation of fatty acids. Mobilization of fats.

Inborn errors of metabolism: Glycogen storage diseases in human- Von Gierke's disease, Pompe's disease, Cori's disease, Mc Ardle's syndrome. Inherited human diseases related to membrane lipids -Gangliosidoses, Gaucher's disease, Niemann-pick disease.

UNIT – III

Amino acid and Protein metabolism : Acid base chemistry of amino acids Amino acid synthesis and metabolism. Primary, secondary, tertiary and quaternary structure of proteins. Super secondary structures. Isomerism and types. Dihedral angles, Ramachandran plot. Hydropathy plot, Models of protein folding. Chaperone assisted protein folding; Amyloid disease, DnaK and DnaJ mechanism of action; Circular dichroism. Sequencing, Peptide synthesis, Interrelationship of protein and carbohydrate metabolism. Urea cycle. Hyperammonemia. Regulation of cell metabolism.

UNIT – IV

Protein purification and enzymes : Cofactors and types; vitamin derived coenzymes (Role of TPP, CoA, FMN, FAD, PLP, Biotin as cofactors in various enzymatic reactions); Fat and Water soluble vitamins, and their deficiencies.

Purification of proteins: Salt fractionation, gel filtration (FC), PAGE-native and SDS, ion-exchange chromatography, affinity chromatography, 2D gel electrophoresis, isoelectric focusing.

Enzyme Kinetics: Characteristic of enzymes, Nomenclature and Classification, Michaelis Menten Kinetics Inhibition of enzyme catalyzed reactions, Multifunctional enzymes, multi-enzyme complexes, coupled reactions, cyclic reactions.

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MOLECULAR BIOLOGY

MBT – CC102

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

UNIT – I

Subject Coordinator : Prof. Pradip K. Chakraborti

Genetic material: Eukaryotic Genome. Organisation of Chromatin (Supercoiling). Repetitive DNA, Types of DNA. Properties of DNA in solution. Dissociation-reassociation kinetics. Cot curves. RNA: RNA genome and its replication. Replication of retroviruses and reoviruses. Reverse transcriptase; RNA dependant RNA polymerase. Types of RNA and their primary and secondary structure. Functions of RNA. Replication of DNA. Role of DNA polymerases and other DNA modifying enzymes. Mechanism of replication. Multiple origins of replication. Proof reading function and fidelity of DNA replication. Extrachromosomal replicons. Replication of circular DNA: Theta model and rolling circle models.: DNA and RNA fingerprinting (including probes and labeling techniques). DNA sequencing and sequencing strategies: Maxam & Gilbert's, Sanger's and Next generation (454, Solexa, SoLID).

UNIT – II

Transcription : Structure of gene, regulatory and transcriptional units. Promoters and other regulatory elements. Special features of eukaryotic genes. Exons and introns. Transcription in prokaryotes. Prokaryotic RNA polymerase and its components. Initiation, elongation and termination of transcription. Role of Rho factor. Transcription and translation are coupled in prokaryotes. Polarity effect. Eukaryotic transcription. Types of eukaryotic RNA polymerases and their role. RNA modifying enzymes. Transcription factors. Termination of eukaryotic transcription. Modification of primary transcript in eukaryotes; Removal of introns, Intron-exon junction. Splice sites. Nuclear splicing, Role of SnRNPs. Self splicing of Type I and Type II introns. Role of 'G' nucleotide. Catalytic activity of RNA. Enzymatic splicing of tRNA. Self cleavage of viroids and virusoids, Ribozyme. Alternate splicing and gene regulation. Cap addition, polyadenylation and RNA editing.

UNIT – III

Mutation and mutagenesis : Physical and chemical mutagens and their effect on DNA. Beneficial mutations; Site directed mutagenesis, oligonucleotide directed point mutations; DNA damage and repair in prokaryotes and eukaryotes. Base and nucleotide excision mechanisms. Direct repair. Mismatch repair, role of methylation, UV induced damage and repair system. Error prone repair. SOS response.

UNIT – IV

Molecular Evolution: Separation, natural selection and evolution of proteins as well as, nucleotide sequences. Molecular clock, evolution by gene duplication and exon shuffling, deleterious genes. Eugenics, Gene frequencies, conservation of gene frequencies. Transposable elements in bacteria. Mobile elements in eukaryotes. Insertional sequences (IS elements), transposons and composite transposons, retroposons. Replicative and non replicative transpositions. Molecular mechanism of transposition events.

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ESSENTIALS OF GENETIC ENGINEERING

MBT – CC103

Credit: 4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time: 72 hours

Subject Coordinator : Prof. Pratima Ray

UNIT – I

Mendelian & Post mendelian genetics : Mendelian and Non-Mendelian inheritance. Inheritance of Quantitative traits. Gene discovery- forward and reverse genetics approaches. Molecular Mapping and tagging. RNAi, siRNA and miRNA. Epigenetics. Comparative genomics: insights into genome organization; application in gene and cis-element detection.

UNIT – II

Genomics of microbes : General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Prokarya, Archaea and Bacteria; Eukarya : Algae, Fungi and Protozoa). Mechanism of gene transfer in bacteria: conjugation, transduction and transformation. Recombination in Bacteriophages. Mapping the structure of bacterial chromosome. Far western blotting, Analysis of DNA-Protein Interactions, Electromobility shift assay, Methyl Interference assay, DNase Footprinting. PCR in molecular diagnostics: Detection of hepatitis, herpes, HIV, and EBV. The role of PCR in detecting minimum residual diseases (MRD).

UNIT – III

Characteristics and application of vectors and enzymes: Introduction to gene manipulation, Plasmid, phages, cosmids, YAC, BAC and Ti-plasmid. Vectors for making RNA probes. Vectors for maximizing protein synthesis, protein purification and enhanced protein export. Vectors with combination of features (Litmus and pin point vector series).

Nucleic acid modifying enzymes (Restriction endonuclease, Polymerase, Kinase, Phosphatase, Methylase, Ligase). Concept of adapters and linkers for insert modification.

UNIT – IV

Cloning and library construction : Construction of genomic and c-DNA libraries. Synthesis of cDNA (mRNA isolation, purification and strategies of cDNA synthesis). Cloning strategies (conventional and advanced cloning strategies). Introducing DNA into bacterial cells. Screening of libraries: Grunstein Hogness method, probe based screening, Blue and white screening, replica plating. Southern, Northern, Western and South-Western blotting. Molecular markers: PCR and derived techniques including RAPD, AFLP, iPCR, qRT-PCR, RFLP. *In-situ* hybridization – FISH, GISH. Micro arrays: DNA and RNA microarrays for transcriptomics and re-sequencing/mutation detection. Applications of recombinant DNA technology.

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PRACTICAL - MOLECULAR BIOLOGY
MBT-CC102

Credit: 4 Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time: 144 hours

1. Instrumentation
2. Preparation of solutions and buffers.
3. Water analysis - Hardness, Conductivity and pH.
4. Extraction and quantification of genomic DNA from *E.coli* DH5 α .
5. Agarose gel electrophoresis of isolated genomic DNA of *E.coli* DH5 α .
6. Qualitative and Quantitative analysis of Carbohydrates and detection of reducing sugars by Folin-Wu-method.
7. Isolation and hydrolysis of starch & casein from biological samples.
8. Quantitative tests of Lipids & their separation by thin layer chromatography (TLC).
9. Qualitative analysis of proteins and amino acids.
10. Separation and identification of amino acids by ascending paper chromatography.
11. Column chromatography (Molecular sieving)

PRACTICAL - ESSENTIALS OF GENETIC ENGINEERING
MBT-CC103

Credit: 4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time: 144 hours

- 1) Preparation of Luria Bertani (LB) medium for bacterial culture and solutions.
- 2) Inoculation of *E.coli* DH5 α strain on LB medium.
- 3) Preparation of competent cells by CaCl₂ method.
- 4) Ligation of linearized pGEM-T vector with an insert.
- 5) Transformation of chemically competent *E. coli* DH5 α with plasmid blue script using CaCl₂ and heat shock method.
- 6) Isolation of plasmid DNA from *E.coli* by alkaline lysis method.
- 7) Agarose gel electrophoresis for plasmid DNA.
- 8) Restriction of λ -DNA, plasmid DNA, bacterial genomic DNA.
- 9) Agarose gel electrophoresis of restricted samples.
- 10) Southern blotting of gel of restricted samples.

EXPRESSION OF GENETIC INFORMATION

MBT – CC201

Credit :4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time : 72 hours

UNIT – I

Subject Coordinator : Prof. Pradip K. Chakraborti

Translation: mRNA, genetic code and its salient features. The structure of tRNA. Genesis of –CCA. Adapter role of tRNA. Wobble hypothesis. Ribosome as the site of protein synthesis. Structure and assembly. Polysomes. Activation of aminoacids: aminoacylation of tRNA. Initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Role of Initiation and Elongation factors. Peptidyl transferase activity and peptide bond formation. Translocation of ribosomes. Fidelity of protein synthesis: GTPase timer. Bioenergetics of protein synthesis.

UNIT – II

Post-translational processing of nascent polypeptide: Acylation, methylation, phosphorylation, sulfation, glycosylation, vitamin C-dependent modifications, vitamin K- dependent carboxylation and proteolytic processing. Inhibitors of protein and RNA synthesis. Role of antibiotics.

Protein Targeting to Organelles : Localization signals. Role of ER and Golgi bodies in protein transport, transport vesicles, endocytosis and exocytosis. Protein transport to nucleus, mitochondrion and chloroplast.

UNIT – III

Regulation of gene expression in prokaryotes : Constitutive and regulated gene expression. Enzyme induction and repression in prokaryotes. DNA binding motifs. Operon Theory: Lac, Trp, Ara and Gal operons. Role of cAMP. Transcriptional termination control via alternate RNA conformations: Attenuation. Regulatory cascades. Control of lytic and lysogenic cycles of lambda phage. Flip flop circuits by genetic recombination. Role of sigma factor in control of sporulation.

UNIT – IV

Regulation of gene expression in eukaryotes : General considerations. Auto regulation, Role of methylation, Response elements. Britten-Davidson models. Control by hormones and other primary messengers. Role of receptor-ligand binding. Adenylcyclase, cAMP and other signal molecules. Regulation of gene expression by chromatin structure. Regulation of Gal genes in yeast. Switching of yeast mating types. Cytoplasmic regulation of gene expression. control of translation. Role of mRNA stability. Hormonal regulation of translation. Role of micro-nutrients. Regulation of rRNA ribosomal protein synthesis.

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MOLECULAR PLANT PHYSIOLOGY

MBT – CC202

Credit :4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time: 72 hours

Subject Coordinator : Prof. M.Z. Abdin

UNIT – 1

Photosynthesis alternative respiration and Hexose monophosphate :

Light harvesting complexes and light reaction. The photosynthetic carbon reduction cycle (PCR), C₄ and Crassulacean acid metabolism (CAM) pathway. Photo-inhibition and photorespiration. Synthesis, transport and storage of starch. Cyanide resistant respiration. Oxidative Pentose phosphate pathway.

UNIT – II

Mineral Nutrition in Plants : Importance of mineral nutrition in plant growth, development and productivity. Criteria for the essentiality of mineral nutrients, and their physiological functions. Nutrient uptake (active and passive uptake); active transport and electrogenic pumps. Assimilation of mineral nutrients (nitrogen, sulphur and phosphorus) and their physiological functions. Biological nitrogen fixation : nif genes, nodulin genes and nodule development. Nitrogen and Sulphur-use efficiency.

UNIT – III

Phytohormones, Photoreceptors and Dissonancy : Structure, biosynthesis and molecular mechanism of action of phytochromes (Auxins, Gibberellins, Cytokinins, Abscisic Acid, Ethylene). Structure and functions of brassinosteroids and polyamines.

Photoreceptors: structure and function of phytochromes and cryptochromes; role in signal transduction. Flower and seed development. Seed dormancy and germination. Types of seed dormancy and methods to overcome dormancy.

UNIT – IV

Stress and Post Harvest Physiology: Abiotic stresses (drought, submergence, low and high salinity, temperature, salt and heavy metal stresses). Role of LEA proteins in stress tolerance. Biotic stresses (insects and diseases), stress induced gene expression. Molecular basis of senescence, ageing and programmed cell death in plants. Molecular biology of fruit ripening and control of post - harvest deterioration of fruits, vegetables and cut flowers.

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PLANT TISSUE CULTURE AND ITS APPLICATIONS

MBT – CC203

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Dr. Alka Narula

UNIT – I

In Vitro culture of plant cells and tissues : Concept and significance of plant tissue culture, principles and methods. Introduction of techniques, basic media, physical parameters, culture of various explants and possible *in-vitro* responses. Single cell and cell suspension culture. Bioreactors.

UNIT – II

In vitro differentiation : Organogenesis, embryogenesis, micropropagation, haploids through anther and pollen culture, endosperm culture and induction of triploids, nucellus culture, ovary ovule and embryo culture and rescue of hybrids, floral bud culture, floral development in *Arabidopsis* and *Antirrhinum*, culture of shoot primordia, stem and root culture, clonal fidelity of regenerants. Bioreactors.

UNIT – III

Application of Tissue culture and Improving Agronomic Traits and conservation : Somaclonal variation and its application in varietal improvement, Use of plant tissue culture technology in crop improvement-selection for drought and salt stress tolerant plants; development of herbicide and pesticide tolerant plants; induction of disease resistant and insect tolerant plants. Synthetic seeds, Cryo-preservation for conservation of plants.

UNIT – IV

Protoplast culture and Vector Independent Transformation : Isolation of protoplasts and somatic hybridization. Applications of somatic hybrids and cybrids in crop improvement. Methods of protoplasts and tissue transformation; microprojectile bombardment, electroporation and microinjection. The advantages and disadvantages of these techniques.

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BIOTECHNOLOGY: ENVIRONMENTAL & ETHICAL ASPECTS

MBT – CC204

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Dr. Humaira Farooqi

UNIT – I

Ethical, Social and Biosafety aspects: Socio-economic and ethical aspects of biotechnology. Environmental laws; Intellectual property rights; Objective of patent system, patentable subjects and protection in biotech; Basic Principles of patent system, UPOV for plant protection. GLP/ GMP.

Objectives and levels of biosafety: Objectives; recombinant DNA safety; biological containment; risk groups and risk analysis. Carategana Protocol; OECD guidelines. Govt of India guidelines for r- DNA technology and GMO's. Ecological impact and biosafety issues of GM crops.

UNIT – II

Biotechnology and Environment Management: Bio-indicators and their applications in environmental monitoring programmes, role of biosensors. Carry over effects of herbicides and pesticides on human health. Bio-fertilizers: types of biofertilizers, production technology for major biofertilizers (*Rhizobium*, *Azotobacter*, *Azolla*, Phosphate solubilizing microbes and Mycorrhizae). Vermi-composting. Bio-pesticides: Development of biopesticides: management of weeds, insect pests and diseases.

UNIT – III

Basic ecological concepts: Habitat ecology, systems ecology, synecology, autecology; Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems and environment; Energy exchange and productivity-food chains and food webs-ecological pyramids, nutrient cycles and recycle pathways; Biomagnifications Population - characteristics and measurement. Communities - habitats, niches, population dynamics, species and individual in the ecosystem. Ecological succession - types and causes.

Research Ethics:

- Concept of Plagiarism.
- Reviewing literature.
- Identification of research problem and proposal writing..

UNIT – IV

Bioremediation: Conventional and advanced technologies for the treatment of sewage and industrial effluents, bioremediation of xenobiotics: characteristics and classification of recalcitrant xenobiotics, metabolic pathways involved in their biodegradation, factors affecting biodegradation of xenobiotics. Phytoremediation and wasteland reclamation.

Biofuels; Generation of biofuels. Different Sources; Production of biodiesel and bioethanol. Advantages of biofuels over petrol. Biofuels risks.

Biodiversity Conservation: Types of Biodiversity and Conservation. Afforestation programmes: NAP and EDF schemes; Gene banks: Objectives and types of gene banks; Gene flow monitoring.

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BIO-STATISTICS

MBT – OE205

Credit :4, Max. Marks: 100 [Sessional Marks: 25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Ehsan A. Khan

To be taught by Professor E.A. Khan

UNIT –I :

Arithmetic Mean, Median and Mode (Theory and simple numerical problem)

Measures of variation : Standard Deviation, variance, coefficient of variation, properties (Theory and simple numerical problems)

Correlation : Types of correlation, methods of correlation, simple, multiple and linear and non linear correlation, spearman's correlation coefficient, Rank correlation (Theory and simple numerical examples)

UNIT – II

Regression : Linear regression, curvilinear regression (for two variables X and Y only), Regression lines by least square methods, Regression equations of X on Y and Y on X only (Theory and simple numerical examples only)

UNIT – III

Tests of significance : Null hypothesis, standard error, level of significance, Degrees of freedom, significance in mean for large samples, significance in means for small samples (students t-test)/ Significance in ratio of two samples. F-test (for difference between variance of two samples), chi square test (Simple numerical examples and theory), Analysis of variance test (ANOVA) for one and tow way classification. Signed Rank test, Dunnet's-t-test (Theory and numerical examples)

To be taught by a teacher from Department of Computer Science

UNIT – IV

Computer applications and data management :

Basics of computer, Input / output tools;

Applications of computer in Biotechnology

- Data handling
- Data acquisition
- Data achieving
- Data mining

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PRACTICAL – EXPRESSION OF GENETIC INFORMATION

MBT – CC201

Credit:3, Max. Marks: 75 [SessionalMarks:15, Exam. Marks: 60] Time : 108 hours

- 1) Effect of temperature and alkali on absorption of DNA: Hyperchromicity.
- 2) Isolation of RNA and its quantitation by UV spectrophotometer.
- 3) Extraction of proteins from biological samples and TCA precipitation.
- 4) Quantification of proteins by Lowry's and Bradford's method.
- 5) Separation of proteins by SDS-PAGE.
- 6) Subcellular fractionation by differential centrifugation.
- 7) Sonication of subcellular fractions and quantification of proteins by micro-Bradford's assay.

PRACTICAL – MOLECULAR PLANT PHYSIOLOGY

MBT – CC202

Credit: 3, Max. Marks: 75 [SessionalMarks:15, Exam. Marks: 60] Time : 108 hours

- 1) Estimation of nitrite in biological samples.
- 2) Estimation of nitrate in biological samples by hydrazine reduction method.
- 3) Assay of *in vivo* nitrate reductase activity in biological samples.
- 4) Estimation of chlorophyll 'a', 'b' and total chlorophyll from biological samples by Hiscox and Israelstam method.
- 5) Isolation estimation of proteins in plant tissues.
- 6) Isolation of acid phosphatase from germinated wheat and determination of its activity.
- 7) Determination of phosphatase activity at different temperature, pH and substrate concentration and calculation of K_m and V_{max} .

PRACTICAL – PLANT TISSUE CULTURE AND ITS APPLICATIONS

MBT – CC203

Credit :4, Max. Marks: 100 [SessionalMarks:25, Exam. Marks: 75] Time : 144 hours

- 1) Preparation of MS and WB media.
- 2) Inoculation of seeds of *Trigonella*, *Brassica* and *Cichorium* sp. and evaluate their percent germination in *in vitro* conditions.
- 3) Study the regeneration potentials of juvenile explants (hypocotyls/ epicotyls) of *Trigonella foenum graecum*.
- 4) Standardization of regeneration protocol of liliium using bulb/ bulb scale/ leaf base.
- 5) Study the effect of 2,4-D in developing micropropagation protocol for *Linum* using cotyledonary leaves.
- 6) *In vitro* endosperm culture.
- 7) Study differentiation potentials of nodal segment/ leaf/ petiole of *Tylophora indica*.
- 8) Raising haploid cultures using anthers of *Datura innoxia* under *in vitro* conditions.
- 9) Inoculation of nodal segment and leaf of *Nicotiana tobaccum* (*from in vitro* source).
- 10) Subculturing of selected plant under *in vitro* conditions.
- 11) Establishment of cell suspension culture from the friable callus.

Seminars / Assignments

MBT – DCE206

Credit:04, Max. Marks: 100 Time : 36 hours

The students will be assigned topics in various areas of Biotechnology for seminars and assignments. The assignments are to be submitted to the mentors for evaluation at the end of semester. The evaluation of students for seminars will be based on the quality of subject matter, templates and presentation. The seminars will be attended by all the teachers of the Department and individually evaluated. Participation of all the students in seminars is compulsory and their attendance will be marked.

Dept. of Biotechnology, Jamia Hamdard

ANIMAL BIOTECHNOLOGY

MBT – CC301

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Dr. Saima Wajid

UNIT – 1

Insect cell and mammalian cell culture :Primary and secondary cultures, cell lines. Upscaling of anchor dependent and suspension cell cultures. Expression of cloned genes in heterologous systems. General considerations. Expression vectors. Promoters and other elements. Selection markers. Production of bio-molecules by rDNA technology, expression of independent and fused proteins, simple and glycosylated proteins. Choice of expression system. Expression strategies. Construction of expression cassettes. Factors effecting high level expression.

UNIT – II

Prokaryotic expression systems : *E. coli*, *Bacillus* and Streptomyces: General features and strong promoters. Natural and hybrid promoters. The pIN series of vectors. Phage promoters. His and other tags. Secretory signal and secretion of r-proteins to periplasm. Inclusion bodies.

Yeast as host for expression of foreign genes :*Saccharomyces* and *Pischia*. Yeast plasmids. Yeast expression vectors. yEP, yIP, yRPs and yAC.

UNIT – III

Insect cells and Baculovirus Expression Vector system : Early and late promoters. Advantages of polyhedron promoter. Indirect cloning in baculovirus. Silkworm larva as biofactory for the production of r-proteins.

Mammalian cell expression system : Strong promoters. SV40 and Cos cells. Shuttle vectors. Helper virus and binary vector system. BPV, EBV and BKV promoters for development of expression vector. Vaccinia virus: Potential applications and pros and cons of its use. Adeno and retrovirus based expression vectors.

UNIT – IV

Proteomics & r-Proteins: *In vitro* cell free protein synthesis: wheat germ S-30, Rabbit reticulocytes; *In vivo* protein synthesis: frog oocyte system; Protein engineering; Interactome: Protein-protein interactions. Proteome analysis. Isolation and purification of r-proteins. Bioactivity of r-proteins. Strategies for commercial production. Gene dose and expression levels.

Commercially available recombinant proteins. Production of GH, insulin; TPA, gonadotropins, HBsAg and other biomedical products by r-DNA technology.

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PLANT BIOTECHNOLOGY

MBT – CC302

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Prof. M.Z. Abdin

UNIT – I

Transgenic technology: Agrobacterium, the natural genetic engineer. Molecular mechanism of *Agrobacterium* mediated genetic transformation of plants. Cloning and expression vectors for plant genes, structure, types, their advantages and disadvantages. Plant Promoters types: Constitutive, tissue specific and inducible; their applications in transgenic technology. Scorable and selectable markers. Transgene integration, copy number, stability, expression, silencing and inheritance in transgenic plants.

UNIT – II

Plastome engineering and applications: Introduction of plastome and vectors used in plastome engineering. Transformation of plastids and their use as bioreactors for the production of various metabolites of therapeutic importance. Plastome engineering for development of male sterile plants and edible vaccines.

UNIT – III

Value addition of plants through genetic engineering-I: Transgenic plants for production of therapeutics; production of edible vaccines through transgenics; genetic engineering for quantitative and qualitative improvement of carbohydrates, proteins, micro-nutrients, vitamins and secondary metabolites.

UNIT – IV

Value addition of plants through genetic engineering-II : Transgenics with increased shelf-life of fruits and flowers. Use of genetic engineering technology for improved lipid metabolism. Herbicide plants through transgenic technology. Genetic engineering for insect-pest resistance and generation of stress tolerant plants for enhanced productivity.

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IMMUNOLOGY

MBT – CC303

Credit: 4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Prof. Pratima Ray

UNIT – I

Overview of immune system: Principles of Immunology – Origin of Immunology and its evolution.

Cells and organs of immune system. T and B cells, macrophages, dendritic cells, NK cells. Primary, secondary and tertiary lymphoid organs.

Types of immunity - Innate and adaptive, Humoral and cell-mediated, Active and passive, PAMP:TLR, Clonal selection theory.

Immunological memory, Antigens and immunogens, B and T cell epitopes; Haptens. Structure and functions of antibodies. Classes of immunoglobulins. CDRs, immunoglobulin fold. Valence, affinity and avidity. Antibody variants - Isotypes, allotypes and idiotypes.

UNIT – II

Recognition of antigens: The immunoglobulin genes: organization and assembly; generation of immunological diversity; Allelic exclusion. Major histocompatibility complex(MHC): structure and organization of MHC Class I and Class II molecules. Antigen processing and antigen presentation. T cell Receptor: $\alpha\beta$ and $\gamma\delta$ receptors; Costimulatory molecules; Superantigens. B cell activation and maturation; B1B and B2B cells; T-cell dependent and T-cell-independent antigens. T cell development and activation. Cytotoxic T cell mediated killing. Complement system and mechanism of its fixation. Complement deficiencies.

UNIT – III

Immune effector mechanisms: Products and factors produced by T-cell activation. Cytokines and chemokines-Interleukins, interferons, growth factors. Antigen-antibody interactions: equilibrium approach. Immunoprecipitation, Agglutination, Immunoelectrophoresis, Immunofluorescence, RIA, ELISA: indirect, sandwich and competitive; Elispot assay. Cytotoxicity assay: MTT assay and Trypan blue; MLR, Hemolytic plaque assay

Flow cytometry and FACS; Confocal microscopy and imaging. MHC inbred, nude, congenic, syngenic and knockout mice – Utility

UNIT – IV

Immune system in health and disease: Immunological tolerance. Autoimmunity and associated disorders. Allergy and hypersensitivity. Transplantation immunology - Graft rejection, graft versus host reaction. Tumor immunology, cancer immunotherapy. Immune response to infectious diseases – viral, bacterial, protozoal. Immunosuppression - immunodeficiency diseases (eg. AIDS).

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BIOTECHNOLOGY AND HUMAN HEALTH

MBT – CC304

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Prof. Pratima Ray

UNIT – I

Hybridoma Technology: Production of murine monoclonal antibodies (MoAbs)-Fusion strategies, HAT Selection; Strategies for production of human MoAbs-Humanization and antigenization of MoAbs-Chimeric, CDR-grafted, SDR-grafted, veneered MoAbs.

Antibody Engineering: Antibody fragments, Antibody gene cloning; Expression of recombinant antibody genes; Next generation display technologies for production of antibodies *in vitro*; Combinatorial libraries and phage display libraries; Bispecific and bi-functional antibodies; Immunoconjugates; Catalytic antibodies.

Clinical applications of MoAbs and engineered antibodies: In diagnostics, therapeutics and other uses.

UNIT – II

Microbial Biotechnology and its applications: Components of culture media, synthetic defined media, complex media, supportive media, enriched media, selective media, differential media; Pure culture isolation by streaking, serial dilution and plating methods; Cultivation, maintenance and stocking of pure cultures, cultivation of anaerobic bacteria; Control of microorganisms- physical and chemical agents; Antibiotics and antiviral agents; Use of prokaryotic and eukaryotic microorganisms in biotechnological applications; Genetically engineered microbes for industrial application-Bacteria and yeast; Recombinant microbial production processes in pharmaceutical industries-Streptokinase, Hepatitis-B recombinant vaccines.

UNIT – III

Fermentation and Food microbiology: Scope, classification based on nature of the products and kinetics of cell growth; Substrates for fermentation; Isolation and preservation of cultures; Design of fermenters, various types of fermenters; Common problems and trouble shooting; Downstream processing; Purification of products; Probiotics and fermented foods; Applications

Cell and enzyme immobilization: Methods of immobilization, kinetics and uses of immobilized enzymes; Bioreactors using immobilized enzymes; Applications of immobilized enzymes in medical science and Industry; Biocatalyst technology, biosensors and analytical applications.

UNIT – IV

Diagnostics: Nucleic acid and protein based diagnostic.

Strategies of Vaccine development: Traditional and new generation vaccines; Live vaccines-(Polio, Rotavirus); Recombinant vaccines (Hepatitis B); Sub unit, VLPS and DNA vaccines; Reverse vaccinology; Newer concept: Rational design based on Structural biology & System vaccinology approach

Preclinical and clinical evaluation of vaccines

Gene therapy: Concept, principle, strategies and applications.

Stem Cells, Tissue Engineering and Regenerative medicine : Types of stem cells, Isolation of stem cells and cryopreservation; Therapeutic cloning, Nuclear reprogramming; Induced pluripotent stem cells; Ethical issues in stem cell research; clinical applications(cardiovascular disease, cancer, spinal injury); Cord blood banking; Tissue engineering: Technology in general and applications; Regenerative medicine.

Course coordinator shall be responsible for completion of course and submitting attendance as well as Sessional marks to Office of HoD. In case of any difficulties, students will contact the course coordinator.

BIOINFORMATICS

MBT – OE305

Credit :4, Max. Marks: 100 [Sessional Marks:25, Exam. Marks: 75] Time : 72 hours

Subject Coordinator : Dr. Alka Narula

UNIT – I

Introduction to Bioinformatics: Introduction and branches of Bioinformatics. Aim, scope and research areas of Bioinformatics.

Databases in Bioinformatics: Introduction. Biological databases. Classification format of biological databases. Biological database retrieval system.

Biological Sequence Databases:

- **National Center for Biotechnology Information (NCBI):** Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Nucleotide Database, Protein Database, Gene Expression Database.
- **EMBL Nucleotide Sequence Database (EMBL-Bank):** Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.
- **DNA Data Bank of Japan (DDBJ):** Introduction, Resources at DDBJ, Data Submission at DDBJ.
- **Protein Information Resource (PIR):** About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR.
- **Swiss-Prot:** Introduction and salient features.

UNIT – II

Bioinformatics resources on the internet.

Computational methods for sequence analysis: Pairwise and multiple sequence alignment for DNA and protein sequences. Local and global sequence similarity.

Methods of sequence alignment: Dot matrix method, Dynamic programming method and Heuristic method.

Scoring matrices: PAM, BLOSUM, Gonnet, Lookup tables.

Tools for similarity search and sequence alignment: BLAST and types, FASTA.

UNIT – III

Genome analysis and Gene identification: Sequencing, Assembly, Annotation, Sequencing pipelines and databases.

Genome comparison and analysis.

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Comparative genomics: Homologs, Paralogs and orthologs; Synteny; Comparative genomics of *Arabidopsis* and *Brassica rapa* / Chimpanzees and human.

Structural analysis of Nucleic acids: Tools for prediction and designing.

UNIT – IV

Application tools: Primer designing.

Molecular imaging and design: CADD, QSAR.

Tools for molecular mapping: QTL, minisatellites, SNP's.

Mapping techniques: JoinMap, MapQTL, LOD Score method for estimating recombination frequency.

Prediction of 3 dimensional structures of proteins: protein secondary and tertiary structure prediction by using techniques: Chou-Fasman/GOR method, comparative modeling, Threading and ab initio structure prediction.

Course coordinator shall be responsible for completion of course and submitting attendance as well as Sessional marks to Office of HoD. In case of any difficulties, students will contact the course coordinator.

PRACTICAL: ANIMAL BIOTECHNOLOGY

MBT – CC301

Credit :3, Max. Marks: 75 [SessionalMarks:15, Exam. Marks: 60] Time : 108 hours

- 1) Preparation of Dulbecco's Modified Eagle's medium for mammalian cell culture.
- 2) Revival and maintenance of CHO cells.
- 3) Trypsinization and storage of CHO cell line.
- 4) Cryopreservation of mammalian cell (CHO).
- 5) Transfection of mammalian cell (CHO) by calcium phosphate co-precipitation method.
- 6) Insect cell culture

PRACTICAL - PLANT BIOTECHNOLOGY

MBT – CC302

Credit :4, Max. Marks: 100 [SessionalMarks: 25, Exam. Marks: 75] Time : 144 hours

- 1) Preparation of synthetic seeds and *in vitro* germination.
- 2) Isolation and culture of protoplast.
- 3) Isolation of total plant genomic DNA by Doyle and Doyle's method from different samples.
- 4) Quantitative and Qualitative analysis of plant genomic DNA.
- 5) Kanamycin sensitivity test in leaf segments.
- 6) Semi-solid and liquid cultures of *Agrobacterium tumefaciens*
- 7) Growth kinetics of *Agrobacterium tumefaciens* in liquid culture.
- 8) Transformation of explants with *Agrobacterium tumefaciens* and regeneration of explants.

PRACTICAL: IMMUNOLOGY

MBT – CC303

Credit: 3, Max. Marks: 75 [SessionalMarks: 15, Exam. Marks: 60] Time: 108 hours

- 1) Ammonium sulphate precipitation of antibodies in serum.
- 2) Preparation of antigen -adjuvant (FCA) emulsion.
- 3) Immunization of mice with antigen-adjuvant formulations.
- 4) Collection of blood from mice and separation of serum.
- 5) Analysis of antibodies raised in immunized mice by indirect ELISA
- 6) Determination of immunogenic proteins by Western Blot Analysis.

Seminars / Assignments

MBT – DCE306

Credit:04, Max. Marks: 100 Time : 36 hours

The students will be assigned topics in various areas of Biotechnology for seminars and assignments. The assignments are to be submitted to the mentors for evaluation at the end of semester. The evaluation of students for seminars will be based on the quality of subject matter, templates and presentation. The seminars will be attended by all the teachers of the Department and individually evaluated. Participation of all the students in seminars is compulsory and their attendance will be marked.

Dept. of Biotechnology, Jamia Hamdard

DISSERTATION

MBT – CC401

Credit :20, Max. Marks: 500 [Sessional Marks:100, Exam. Marks: 400] Time : 720 hours

1. Research Project and submission of dissertation.
2. Preparation and submission of Review article

Dept. of Biotechnology, Jamia Hamdard

FACULTY OF SCIENCE

HAMDARD NAGAR, NEW DLEHI

M.Sc. Bye-Laws

Foundation Course – for all students of the faculty

1. Programme : Master of Science (M. Sc.)

M.Sc. in the following subjects:

- i) Biochemistry
- ii) Biotechnology
- iii) Botany
- iv) Chemistry
- v) Toxicology
- vi) Clinical Research

| | |
|-------------------|------------|
| Foundation course | 001 |
|-------------------|------------|

Each programme shall be denoted by three digit code as follows :

- | | |
|----------------------|-----|
| a) Biochemistry | 507 |
| b) Biotechnology | 508 |
| c) Botany | 509 |
| d) Chemistry | 510 |
| e) Toxicology | 511 |
| f) Clinical Research | 540 |

Each course of programme shall be given a course number which shall be preceded by three abbreviation as follows :

| | |
|----------------------|-----|
| a) Biochemistry | MBC |
| b) Biotechnology | MBT |
| c) Botany | MBO |
| d) Chemistry | MCH |
| e) Toxicology | MTX |
| f) Clinical Research | MCR |
| g) Foundation course | MFC |

These all are full time regular courses.

The Core, discipline Centric and Open elective Courses shall be abbreviated as follows :

| | | |
|-----------------------------|---|-----|
| Core Course | : | CC |
| Discipline Centric Elective | : | DCE |
| Open Elective | : | OE |

These abbreviations shall be preceded course number of each course of programme.

During an academic year, a candidate who is enrolled in the M.Sc. Programmes, shall not be allowed to enroll for any other full-time programme of study and shall not appear in any other examination of a full time course of this or any other university.

2. Duration :Two Years of Four semesters (two in each year) designated as under:

- 1st Semester - July-Nov of 1st year
- 2nd Semester - Dec-April of 1st year
- 3rd Semester - July-Nov of 2nd year
- 4th Semester - Dec-April of 2nd year

Teaching days in each semester shall be not less than **90 days**.

Medium of instruction and examinations : English

3. Eligibility of Admission:

All candidates seeking admission to any of the above M.Sc. programmes must appear in the Entrance Test conducted by Jamia Hamdard. Also, the candidates should fulfill the following qualifications for admission to as mentioned below for each programme :

M.Sc. Biochemistry: Must have passed B. Sc. from a recognized university under 10+2+3 system with Biochemistry or Chemistry as one of the subjects and secured at least 45% marks in the aggregate.

M.Sc. Biotechnology: Must have passed B. Sc. from a recognized university under 10+2+3 system with Biological Sciences and secured at least 45% marks in the aggregate. The candidates having passed B.Sc. (Agriculture) or B.V. Sc. are also eligible.

M.Sc. Botany: Must have passed B. Sc. from a recognized university under 10+2+3 system with Botany/Plant Sciences as one of the subjects and secured at least 45% marks in the aggregate.

M.Sc. Chemistry : Must have passed B. Sc. or equivalent examination from a recognized university under 10+2+3 system with Chemistry as one of the subjects and secured at least 45% marks in the aggregate.

M.Sc. Toxicology: Must have passed B. Sc. from a university recognized by Jamia Hamdard under 10+2+3 system with any three of the following subjects: Botany, Zoology, Chemistry, Biochemistry, Biotechnology, Microbiology, Environmental Biology or a subject of Life Sciences and secured at least 45% marks in the aggregate. Candidates who have studied biology at 10+2 level and have B. Pharm./B.V.Sc./B.Sc.(Ag.) degree are also eligible to apply. The minimum required percentage will be 45% in aggregate.

M.Sc. Clinical Research : Candidates with any of the following qualifications from a university recognized by Jamia Hamdard, with at least 45% marks in aggregate, shall be eligible for admission to this programme:

MBBS / BDS / BAMS / BUMS / BVSc./B.Pharm/BSc-Nursing/BOT/BPT/ BSc-Medical Lab. Techniques/BSc with Biochemistry/Biotechnology/ Microbiology/ Zoology/ Bioinstrumentation or any other life sciences/ allied health sciences.

4. Course Structure :

- a) Foundation course will be of 8 credits (200 marks) and 200 hours duration. The internal assessment (Sessional Tests) shall be of 50 marks while the final examination will be of 150 marks. There will be three Sessional tests. In each sessional test question from all the units will form the question paper. Each unit, on an average would be allocated two marks each in each sessional.
- b) There shall be not less than **twenty credits** of courses in each semester, e.g., there may be 4 theory courses of 4 credits and a lab course of 4 credits or 5 theory courses of 3 credits each and a lab course of 5 credits, making each semester of 20 credits. Similarly, there could be seminars, etc with not less than 3 or 6 credits. In such cases credits to theory and practical papers are to be adjusted accordingly.
- c) A project of not less than 20 credits may be prescribed in the course structure in 4th semester in place of theory papers or theory papers and project. The project work may involve experimental work and literature survey on a specified topic.
- d) Though for project work the topics shall be given in advance, the credits assigned for the project work shall be awarded at the end of 4th semester. For project work, the Head of the Department shall call a meeting of all the teachers of the Department and assign

- appropriate number of students to each teacher to act as the supervisor for project work. The student in consultation with the supervisor shall select a topic for the project work and inform the Head of the Department.
- e) The contents of each theory course shall be divided into four units. Each unit shall preferably have equal teaching hours.
 - f) At the end of 2nd and /or 4th semester(s) a department may arrange summer training of students for 6-12 weeks in an industry/research organization/university.

5. Attendance

- a) All Students must attend every lecture and practical class. However, to account for unforeseen contingencies, the attendance requirement for appearing in the semester examinations shall be a minimum of 75% of the classes prescribed for each course.
- b) In order to maintain the attendance record of a particular course, a roll call will be taken by the teacher in every scheduled lecture and practical class. For the purpose of attendance, each practical class will count as one attendance unit, irrespective of the number of contact hours. Attendance on account of participation in the prescribed and notified activities such as, NCC, NSS, Inter University sports, educational tours/field work, shall be granted provided the participation of the student is duly verified by the officer-in-charge and is sent to the Head of the Department within two weeks of the function/activity, etc.
- c) The teacher shall consolidate the attendance record for the lectures and practicals at the end of each month and submit to the Head of the Department. At the end of the semester, the teacher shall consolidate the attendance record for the whole semester and submit it to the Head of the Department. The statement of attendance of students shall be displayed by the Head of the Department on the Notice Board. A copy of the same shall be preserved as record. Attendance record displayed on the Notice Board shall be deemed to be a proper Notification for the students and no individual notice shall be sent to any student.
- d) If a student is found to be continuously absent from the classes without any information for a period of 30 days, the concerned teacher shall report the matter to the Head of the Department who will report the matter to the Registrar through Dean of the Faculty for appropriate action that will include striking off the name of such student(s) from the rolls. Such a student may, however, apply for re-admission within 7 days from the date of issue of the notice of striking off the name of such student(s) from the rolls. The request for re-admission may be considered by the Dean of the Faculty. Such a

student shall not be eligible for re-admission after the prescribed period of 7 days. The re-admission shall be effected only after the payment of prescribed re-admission fee.

- e) **A student with less than 75% attendance in a course in a semester shall be detained from appearing in the semester examination of that course. The Dean of the Faculty may consider application for condoning up to 5% of attendance on account of sickness, provided the medical certificate, duly certified by a Registered Medical Practitioner/Public Hospital had been submitted in the office of the Head of the Department at the time of rejoining the classes immediately after the recovery from illness.** The HoD shall forward such cases along with all related documents to the Dean. The cases of students with less than 70% attendance may be forwarded to the Vice-Chancellor through Dean for considering these case to further condone the attendance as special case.
- f) A student detained on account of shortage of attendance in any semester shall be re-admitted to the same class in the subsequent academic year on payment of prescribed fees applicable in that year to complete the attendance requirement of that course.

6. Internal Assessment :

The Internal Assessment marks will constitute upto 30% of the total marks allotted to a course. For awarding Internal Assessment marks, there shall be three Sessional tests of 5 marks each for each course in a semester. First sessional test shall be taken in the beginning of the session, 2nd after two months of the session, and the 3rd sessional test 15 days before the commencement of the final semester examination. 5 marks shall be allotted for assignment, while 5 marks will be allotted to the attendance in the respective courses in the following manner :

| | |
|--|----------|
| 100% attendance | 05 Marks |
| 75 - 99.9% attendance | 04 Marks |
| 60 – 74.9% attendance | 03 Marks |
| below 60% attendance but not less than 50% | 02 Marks |

For the evaluation of lab work, laboratory notebook, practical test/viva voce shall be taken into account. The marks shall be awarded by the respective teachers conducting the practical course. For sessionals and during the examination, no department shall permit discontinuance of classes. Under the compelling circumstance such as sickness of the student or mourning in the family the candidate may be given another chance. For sickness only a credible medical certificate issued by a hospital shall be considered. In case of causalities a letter from the parents would be required.

For Foundation course, there shall be three Sessional tests of 10 marks each. In each sessional, question from all the units shall form the question paper. Each unit, shall be allocated 2 marks each in each sessional. These sessional tests shall be taken in the manner as described for internal assessment of other courses. 10 marks will be allotted for assignment, while 10 marks for the attendance in the following manner :

| | |
|--|----------|
| 100% attendance | 10 Marks |
| 75 - 99.9% attendance | 08 Marks |
| 60 – 74.9% attendance | 06 Marks |
| below 60% attendance but not less than 50% | 04 Marks |

The questions for the Foundation Course sessional test should be sent to the Dean, Faculty of Science by respective Head of the Departments one week prior to the commencement of the test.

For assignment, a list of topics from each unit of Foundation Course should be sent by the teachers, who are involved in teaching Foundation Course through Head of the Departments. The list of these topics should be provided to the Dean latest by 1st week of August. The student will have choice to select a topic from the list. The assignment will be submitted in the office of the Dean in the month of September by the students, which will be sent, thereafter, to Head of the Departments for evaluation.

7. Semester Examination:

Each credit should be given weightage of minimum 25 marks. Foundation course shall be of 08 credits (200 marks) and 200 hours duration. The internal assessment (Sessional Tests) shall be of 50 marks, while the final examination shall be of 150 marks.

There shall be not less than two theory courses and one lab course in each semester, except 4th Semester. The detailed contents of the courses of studies shall be prescribed by respective Board of Studies and shall be reviewed regularly.

The botanical tour/educational tour shall be organized in the vacations. The final year students shall participate as per University rules and regulations.

A student who fails in theory papers of end semester examination may be given a chance to appear in 3 papers in Makeup examination to clear those papers. In no case shall it be allowed to the students who abstain from appearing in the semester examination. Students who are detained due to shortage of attendance shall not be allowed to appear in the Makeup examination.

Semester examination shall be held at the end of each semester as per schedule given in the Academic Calendar of the Faculty.

Upto maximum of seven days preparatory holidays may be given to the examinees before the start of the semester examinations.

The question paper for semester examinations, shall be set either by the external examiner or an internal examiner. The Board of Studies of a department shall draw a panel of name of examiners, both internal and external, for approval by the Vice chancellor. **If the external examiner is unable to send the question paper by the deadline set by the examination branch of the University, the Head of the Department after consultation with the examination branch shall get the paper set internally by a faculty.** The papers set by the examiners can be moderated in consultation with the teacher who taught that course. Teachers appointed on contractual basis with appointment of less than one academic session, and temporary as well as ad-hoc teachers may not ordinarily be appointed as examiners. All such teachers, however, will be expected to assist in the practical examination.

The question paper shall have five questions. There shall be one question from each of the 4 units of the course and one question shall contain objective type/short answer questions covering all the units of the course. The candidate shall have to answer all the five questions. There shall, however, be internal choice within a unit. The choice shall be given by setting alternative questions from the same unit. The question paper should be such that it covers all the topics of that course.

The duration of the semester examination of a theory course shall be Three hours. Practical exams of a lab course shall be of at least four hours duration. The practical examination shall be conducted by an external and an internal examiner and assisted by other teachers.

For projects, **each student shall submit three typed bound copies of his/her project work to the supervisor(s)** by the end of the 4th semester. A student shall not be entitled to submit the project report unless he/she has pursued project work during 4th semester under the guidance of a duly appointed supervisor(s). The report shall embody the candidates own work and an up-to-date review of the subject area. The write-up shall detail a critical assessment of the subject area and indicate in what respect the work appears to advance the knowledge of the subject concerned and future course of investigation required.

The project report shall be examined by a Board of Examiners and the student shall have to appear for viva-voce. The Board of Examiners shall consist of the following :

- An external examiner
- Head of the Department
- A senior teacher of the Department
- Concerned Supervisor(s)

The Board shall examine the project report of all the students, **conduct the viva-voce and award marks for the project and viva-voce. All other teachers of the department will also be invited by the Head of the Department to be present during the examination.** In case a student fails to secure the minimum pass marks, he/she may be asked to appear in the viva-voce again, or he/she may be asked to revise the project report in the light of the suggestions of the examiners and resubmit. For this, he/she will have to enroll as an ex-student in the next session. A resubmitted project report will be examined as above and viva voce shall be conducted along with other students.

8. Choice Based Credit System (CBCS)

Definitions of key words:

- a) **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
- b) **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
- c) **Course:** Usually referred to, as 'papers' is a component of a programme. All courses need not carry the same weight. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/term papers/assignments/ presentations/ self-study etc. or a combination of some of these.
- d) **Credit Based Semester System (CBCS):** Under the CBCS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.
- e) **Credit Point:** It is the product of grade point and number of credits for a course.
- f) **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.
- g) **Cumulative Grade Point Average (CGPA):** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.
- h) **Grade Point:** It is a numerical weight allotted to each letter grade on a 10-point scale.
- i) **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
- j) **Programme:** An educational programme leading to award of a Degree, diploma or certificate.

- k) **Semester Grade Point Average (SGPA):** It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.
- l) **Semester:** Each semester will consist of 15-18 weeks of academic work equivalent to not less than 90 actual teaching days. The odd semester may be scheduled from July to November and even semester from December to April.
- m) **Transcript or Grade Card or Certificate :** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA earned till that semester.

9. Semester System and Choice Based Credit System

The semester system accelerates the teaching-learning process and enables vertical and horizontal mobility in learning. The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'Cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

10. Types of Courses :

Courses in a programme may be of three kinds according to CBCS : Core, Elective and Foundation.

a. Core Course:- There may be a Core Course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

b. Elective Course:- Elective course is a course which can be chosen from a pool of papers. It may be:

- Supportive to the discipline of study.
- Providing an expanded scope.
- Enabling an exposure to some other discipline/domain.
- Nurturing student's proficiency/skill.

An elective may be "Open Elective" focusing on those courses which add generic proficiency to the students. An elective may be "Discipline centric" or may be chosen from an unrelated discipline. It may be called an "Open Elective."

c. Foundation Course:-

The Foundation Courses may be of two kinds: Compulsory Foundation and Elective foundation. "Compulsory Foundation" courses are the courses based upon the content that leads to Knowledge enhancement. They are mandatory for all disciplines. Elective Foundation courses are value-based and are aimed at man-making education.

11. Classification of Result :

- a) Two methods -relative grading or absolute grading- have been in vogue for awarding grades in a course. The relative grading is based on the distribution (usually normal distribution) of marks obtained by all the students of the course and the grades are awarded based on a cut-off marks or percentile. Under the absolute grading, the marks are converted to grades based on pre-determined class intervals. To implement the following grading system, the colleges and universities can use any one of the above methods.
- b) Following grading system with 10 point scale shall be followed to represent performance of students in the examination:

Grades and Grade Points :

| Letter Grade | Grade Point | Marks |
|---------------------|--------------------|--------------|
| O (Outstanding) | 10 | 90 – 100 |
| A+ (Excellent) | 9 | 80 – 89 |
| A (Very Good) | 8 | 70 – 79 |
| B+ (Good) | 7 | 60 – 69 |
| B (Above Average) | 6 | 50 – 59 |
| C (Average) | 5 | 45 – 49 |
| P (Pass) | 4 | 40 – 44 |
| F (Fail) | 0 | Less than 40 |
| AB (Absent) | 0 | |

Earned Credits (EC) :

The credits for the courses in which a student has obtained P (minimum passing grade for a course) or a higher grade in the semester exam shall be counted as credits earned by him/her. Any course in which a student has obtained 'F' or 'AB' grade shall not be counted towards his/her earned credits.

12. Computation of SGPA and CGPA :

Following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

- a) SGPA (Semester Grade Point Average) shall be awarded on successful completion of each semester.

- b) CGPA (Cumulative Grade Point Average), which is the Grade Point Average for all the completed semesters at any point in time shall be awarded in each semester on successful completion of the current semester as well as all of the previous semester. In 1st semester, CGPA is not applicable.

13. Calculation of SGPA and CGPA of A Student in a Semester :

$$\text{SGPA} = \frac{\sum (\text{Earned Credits} \times \text{Grade Point})}{\sum (\text{Total Course Credits in a Semester})}$$

$$\text{CGPA} = \frac{\sum_{j=1}^m (\text{Earned Credits} \times \text{grade point})}{\sum (\text{Total Course Credit in a Semester})}$$

Where m is the number of semesters passed

14. Promotion :

- a) Promotion from 1st semester to 2nd semester and from 3rd semester to 4th semester shall be automatic.
- b) A student shall be promoted to the 3rd semester of the programme if he/she has passed in each theory and practical courses separately of 1st and 2nd semesters. Provided that a student may carry over a maximum of 8-9 credits (equivalent to two-three theory papers, which may be of 3 or 4 credits each) of courses uncleared, to the 3rd semester). A candidate will be given a total number of 2 attempts, inclusive of the first attempt, to clear the papers in which he/she fails. For such students, promotion to the next higher class will be considered subject to rules relating to passing the 1st and 2nd semester examinations within two academic years. Award of degree shall be subject to successfully completing all the requirements of the programme of study within four years from admission. A student who fails in theory papers of end semester examination may be given a chance to appear in 3 papers in Make-up examination to clear those papers. In no case shall it be allowed to the students who abstain from appearing in the semester examination.
- c) Candidates who are unable to appear in the examination because of serious illness at the time of examinations may be given another chance. The request has to be processed through the Head of the Department to the Vice Chancellor. The Vice chancellor may look into the merit of the case and decide accordingly.

15. Classification of Successful Candidates :

The result of successful candidates who fulfill the criteria for the award of M. Sc. shall be classified after the 4th semester, on the basis of his/her CGPA of all the four semesters.

Classification shall be done on the basis of following criteria:

- a) He/She will be awarded “Ist Division” if his/her final marks are greater than or equal to 60% in all the semester examinations in the first attempt.
He/she will be awarded “Ist Division” if his/her final CGPA is 7 or above
- b) He/She will be awarded “2nd Division” if his/her final marks are greater than or equal to 50% but less than 60% in all the semester examinations in the first attempt.
He/she will be awarded “2nd Division” if his/her final CGPA is 6 or above but less than 7
- c) He/She will be awarded “Pass” if his/her final marks are greater than or equal to 40% but less than 50% in all the semester examinations in the first attempt.
He/She will be awarded “Pass” if his/her final CGPA is 5 or above but less than 6.
- d) He/She will be treated as “fail” if his/her final marks are less than 40% in all the semester examinations in the first attempt.
He/She will be treated as “fail” if his/her final CGPA is less than 5

16. Span Period :

- a) 1st and 2nd Semester Exams: Within two years from the first admission to the programme
- b) All requirement of M. Sc. degree within a total period of four years from the date of their first admission.

17. Improvement :

A candidate who wishes to improve the previous performance will be allowed to do so as per the following regulation :

- a) A student shall be allowed only once to reappear in the semester examination of up to four theory courses along with regular students of that semester to improve upon the previous performance. The examination fee charged from such candidates shall be double the current examination fee.
- b) Such a student shall inform the Head of the Department in writing of his/her intention to improve the performance two months before

the date of semester examination is to be held. Only the candidates who have attained at least C grade shall be eligible for improvement of performance.

- c) If the student improves the performance, he/she shall be required to submit the earlier mark-sheet/degree. A new mark-sheet and degree shall be issued. The new mark-sheet/degree shall bear the year in which the student improved the grade.
- d) In case the grade obtained in improvement is lower than the one obtained earlier, the higher grade shall be retained.

18. Consolidated Mark sheet :

On successful completion of the course, a consolidated marksheet consisting of marks of all the Semesters shall be issued to the students by the Examination Section.

19. Award of Gold Medal :

Gold Medal will be given to the toppers of each course. However, only the overall topper in all the disciplines of any course will be given Gold Medal by the Chief Guest in the Convocation. Criterion for giving the Gold Medals will be percentage of marks. Therefore students with highest % of Marks will be given the Gold Medal in each discipline of a course.





JAMIA HAMDARD

(HAMDARD UNIVERSITY)

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956 vide Notification No. F.9-18 / 85-U. 3 dated 10.5.1989 of the Government of India)

Accredited by NAAC in 'A' Category
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